THE SPATIAL AND TEMPORAL VARIATION OF SOUND SPEED IN THE CALIFORNIA CURRENT SYSTEM OFF MONTEREY, CALIFORNIA

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Monterey, California

THESIS

THE SPATIAL AND TEMPORAL VARIATION OF SOUND SPEED IN THE CALIFORNIA CURRENT SYSTEM OFF MONTEREY, CALIFORNIA

by

John George Hughes

December 1975

Thesis Advisor: J. Wickham

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The Spatial and Temporal Variation of Sound Speed in the California Current System off Monterey, California

by

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I. INTRODUCTION

A. PURPOSE

The purpose of this thesis is to study small scale spatial variations in the sound speed field and their time changes with approximately monthly time increments in the upper 500 m of an area associated with a complex frontal region. The size and character of the variability are shown by using isotachs to contour the sound speed field over each vertical section through that region. The relationship of the sound speed field to the water mass distribution is also discussed. Cross-correlation coefficients of sound speed profiles are utilized in order to define a sound speed variability length.

B. BACKGROUND

1. Sound Speed

Sound speed is an increasing function of salinity, temperature and pressure. A number of equations relating sound speed to salinity (S), temperature (T) and pressure (P) have been developed. Wilson's October equation (Wilson, 1960) was used to calculate sound speeds in this study. The importance of these variables to sound speed varies greatly. According to Wilson's October equation; at 7° C, a change of 1° C in temperature results in a 3.9 m/sec change in sound speed; a change of 1 ppt salinity results in a 1.3

m/sec change in sound speed; and a 1 m change in depth results in a .017 m/sec change in sound speed (Kinsler and Fry, 1962). It is apparent, in view of the normal variations in the sea of T, S, and P, that temperature is by far the most significant variable in the upper ocean layers. The error resulting from the use of Wilson's October equation was not considered significant in the qualitative evaluation of the sound speed field or in the determination of the cross-correlation function and the cross-correlation coefficient, since they both are measures of relative sound speed variability.

Sound speed has two obvious uses in oceanography. The physical oceanographer utilizes sound speed as a property to define water masses and to describe water mass boundaries, and also to infer physical conditions (e.g., vertical advection) by virtue of its spatial and temporal variations. Naval oceanographers apply directly their knowledge of sound speed distribution in describing the propagation of acoustic energy in the ocean.

2. Frontal Zones

A front is defined as the leading edge of a zone separating unlike water masses (Griffiths, 1965). A front is also identified in the literature as an oceanographic front, an oceanic front, an oceanic frontal zone, or a thermal front. The addition of a geographic name to any of the above indicates a specific feature at a specific location such as

the California Front, or Maltese Oceanic Frontal Zone. Fronts are characterized by marked horizontal and vertical gradients in temperature, salinity, sound speed and other properties. Fronts may be ill-defined, transient and associated with periodic vertical motions and displacements (Lafond and Lafond, 1966). Frontal zones usually occur at boundaries between current systems. They may be 200 to 400 miles wide and consist of a number of smaller fronts. These smaller features are individually and collectively referred to as fronts (Lafond and Lafond, 1971).

Frontal zones are especially important because the most intense horizontal variability in oceanographic parameters is found there. As a result of their importance many frontal zones throughout the world have been the subject of intense study. Two frontal zones under investigation include the California Front (Lafond et al., 1971) between the western boundary of the California Current and waters of the North Pacific gyre approximately 500 miles off the California coast; and the Maltese Oceanic Frontal Zone (Miller, 1972) lying East of Malta in the Mediterranean Sea. In both studies isothermal contours were used to identify and describe the frontal zone. In this discussion sound speed is used as the descriptive parameter. Disregarding the question of the relative worth of one parameter over the other as a descriptor, comparisons will be made freely between this study and the two referred to above.

Supporting evidence for the validity of these comparisons is derived from an analysis of the relative contributions of salinity and temperature to sound speed described by the following relation

$$dC = \frac{\partial C}{\partial S} \cdot dS + \frac{\partial C}{\partial T} \cdot dT$$

which can be rewritten as

$$dC = [\ \frac{\partial C}{\partial S} + \frac{\partial C}{\partial T} (\frac{dT}{dS})\ ]\ dS$$

where C is sound speed, S is salinity, and T is temperature. The relative importance of temperature and salinity changes is given by comparison of the two terms within the brackets. They are evaluated from values of $\frac{\partial C}{\partial S}$ and $\frac{\partial C}{\partial T}$ given previously and from $\frac{dT}{dS}$, which can be determined from the slope of the temperature-salinity profiles representing this area's water masses as shown in figure 1. For the case where salinity makes the greatest contribution, indicated by the portion of the August, 1972 line below 450 meters, there results a value for $\frac{dT}{dS}$ of 1.25° C/ppt. For these values the result is

$$dC = (1.3 + 4.88)\ dS \quad .$$

Therefore about 80% of the sound speed variability is due to temperature. Even in this extreme case, which is only locally

significant, temperature is the dominant factor in determining sound speed, although the contribution from salinity is not negligible.

3. Oceanographic Structure in the Study Area

The subject of study here is predominantly one vertical cross section running 50 miles West from a point (Latitude 36° 40'N, Longitude 122° 0'W) located just off Monterey Bay. The area is shown in figures 2 and 3. This section transects the boundary of the colder less saline California Current water flowing equatorward and the warmer more saline water flowing poleward identified as the "countercurrent", "undercurrent" or "Davidson Current", depending on the season and the author. The structure is very complex in the region of strong shear between the opposing currents due to various dynamic mixing processes. Many authors including Sverdrup, Johnson and Fleming (1942), Reid (1963), Reid, Roden and Wyllie (1958), Wooster and Reid (1963), Wyllie (1966), Wooster and Jones (1970), Milnar (1972), Brown (1974), Wickham (1975), Blumberg (1975) and Greer (1975) have treated the structure of the California Current system and related subjects. Recent work by Wickham (1975), Blumberg (1975) and Greer (1975) indicates that the current has several branches or filaments and demonstrates variability both spatially and temporally on various scales. These authors also indicate that the transverse dimension of the current features is small, especially in the poleward flow, on the order of tens of kilometers or less across.

II. DATA COMPILATION

A. DATA COLLECTION

A line of 16 stations, identified by 300 series numbers, was established covering a total distance of 50 nm from a reference point at Latitude 36° 40'N, Longitude 122° 00'W and extending westward. This equates to a station spacing of 3.1 nm or 5.5 km. On one occasion, August, 1973, this line of stations was supplemented by two additional lines of stations identified by 100 series and 200 series numbers. Station locations are illustrated in figures 2 and 3.

The original research plan called for stations to be occupied at monthly intervals over the period from August, 1973 to August, 1974 using a Bisset-Berman continuous profiling salinity, temperature, and depth recorder (STD). Corroboration was planned to be acquired from concurrent Nansen casts. However, due to equipment problems and inclement weather, this goal could not be achieved totally. The goals were met for three vertical cross sections from August, 1973; and one each from October, 1973; November, 1973; December, 1973; January, 1974; and August, 1974. Data from these sections are the basis for this study.

B. DATA REDUCTION

Output from the STD is in the form of analog traces of temperature and salinity versus depth. The salinity traces

were contaminated by erroneous fluctuations (spikes) of salinity which had to be eliminated. These salinity spikes resulted from the inability of the conductivity cell, which is temperature dependent, to compensate properly for sharp temperature gradients. Salinity spike removal was accomplished by first comparing salinity traces taken as the instrument was lowered against traces taken as the instrument was raised. If the salinity spikes were present in both traces at the same depth in opposite directions, they were considered erroneous. The spikes were then smoothed using eye interpolation. The error introduced by this technique was not considered significant due to the small salinity range and the small effect that salinity has on sound speed.

The analog traces were digitalized for further analysis. Digitizing was done on a Calma Company Model 480 digitizer owned and operated by Fleet Numerical Weather Center, Monterey, California. The instrument converts an analog trace to a digital output expressed as inches of stylus travel from a reference point. Since stylus position is recorded every .01 inch, sampling interval becomes a function of scale. Based on the STD analog scales, .01 inch of stylus travel equates to .32 m of depth at the (0-300 m) scale and .75 m of depth at the (0-750 m) scale; a .005°C temperature increment for a scale of 5°C width; and a .002 ppt salinity increment for a salinity scale of 2 ppt width. The output is encoded on a seven track magnetic tape. Various codes are added as header information for identification and scaling.

A computer program DIGISTD, listed at the conclusion of this presentation, was utilized to read the seven track tape and convert inches of stylus travel to data values. Reconciliation of the data was accomplished at this point by the introduction of a constant correction for temperature (-.08°C) and for salinity (.04 ppt) in the DIGISTD program based on a comparison of the STD data and independent concurrent Nansen data. Output from the DIGISTD program was encoded on nine track tape, although the program allowed paper and card output as well. The output format gave temperature, salinity, sigma-t and sound speed as functions of depth at .3 m or .75 m increments listed by station and month.

Subsequent data reduction was accomplished by generating an array of sound speed values as a function of depth and station number for each vertical cross section. Sound speed values were specified at whole number depth steps of 2 meters from 0 to 500 m or shallower at each station as required. Linear interpolation was utilized to assign a sound speed value at each designated depth. Interpolation was accomplished by the procedure below. Given a specified depth D_1, two depth data points, D_{-1} and D_{+1}, were selected such that the absolute value of $|D-D_{-1}|$ and $|D-D_{+1}|$ were both minimum and $D_{-1} < D < D_{+1}$. Then, letting SV_{-1} and SV_{+1} be the respective sound speed values of D_{-1} and D_{+1} , the sound speed value at depth D, represented by SV, was computed by the equation

$$SV = SV_{-1} + (SV_{+1} - SV_{-1}) \frac{(D - D_{-1})}{(D_{+1} - D_{-1})}$$

A measure of the error in the interpolated value of SV was determined by calculating the mean absolute difference in the sound speeds at the two data points, D_{-1} and D_{+1}, averaged over one vertical cross section.

$$\text{MEAN SV ERROR} \leq \frac{1}{N} \sum_{i=1}^{N} |SV_{+1} - SV_{-1}|$$

Since the maximum mean absolute difference was .036 m/sec, the resulting error was considered insignificant.

Holidays in the data were also filled using the same linear interpolation technique. Instead of specifying one depth, D, N depths D_n were specified such that

$$N = \frac{(D_{-1} - D_{+1})}{2} + 1$$

and

$$SV_n = SV_{-1} + (SV_{+1} - SV_{-1}) \frac{(D_n - D_{-1})}{(D_{+1} - D_{-1})} \qquad n=1,2,\ldots,N$$

where SV_n is the sound speed value computed at depth D_n. In all cases, holidays were only localized and of limited extent.

When interpolated values of SV had been assigned to all depths at 2 m increments, mean SV gradients were calculated for 2 m and 10 m intervals. The statistics of these gradients are found in the section on analysis.

III. ANALYSIS

A. SOUND SPEED FIELD ANALYSIS

1. Introduction

The sound speed fields are illustrated in figures 4 through 11. It has been stated previously that sound speed is used by physical oceanographers to identify water masses because, as a function of salinity, temperature, and pressure, it reflects changes in these variables. Higher sound speed tends to imply higher values of both temperature and salinity and vice versa. Since temperature is the dominant factor in determining sound speed, higher values of sound speed may reflect merely higher values of temperatures with lower or equal values of salinity, and conversely.

The two basic water masses in the area are "southern" water and "northern" water and their identifying characteristics are higher salinity and temperature and lower salinity and temperature respectively. Sound speed features such as sound speed maximums and minimums reflect the presence of least mixed portions of the respective water masses. In considering sound speed as a water mass descriptor, sound speed variability due to pressure was ignored due to shallow depths, less than 500 meters, of the region analyzed.

2. Major Sound Speed Field Features

As stated previously, sound speed field features will now be discussed in terms of the features defined by Lafond

and Lafond (1966), (1967), (1967), and (1971). In their discussions Lafond and Lafond defined characteristic features of the thermal field including ridges, maximums, minimums and frontal zones. Similar features were found and identified in the sound speed fields of this study. The following discussion considers the individual sound speed field features and their significance.

A ridge structure is indicative of a minimum in the horizontal sound speed distribution and represents a colder less saline water mass. Examples of ridge features are shown at station 108 in figure 4 and station 316 in figure 9. The scales vary considerably between the two examples. Lafond and Lafond (1966) defined ridge features with horizontal scales on the order of 15 nm by 45 m to 50 m in the vertical.

Sound speed maximums and minimums are defined by closed isotachs and indicate extremes both horizontally and vertically. Maximums represent warmer more saline water masses of limited horizontal and vertical extent. Well defined sound speed maximums are illustrated at station 316 of figure 7 and station 316 of figure 8. Less well defined examples are illustrated at stations 305, 314 and 316 of figure 10 and station 304 of figure 11. Similarly, sound speed minimums represent colder less saline water masses of limited extent. Sound speed minimums in this study are not as well defined as are maximums and ridge features. An example of a sound speed minimum occurs at station 108 in figure 8.

A frontal zone is characterized by sharp horizontal gradients and sloping and/or irregular isotachs marking the boundary between water masses. Good examples of frontal zones are illustrated between stations 210 and 202 in figure 5; stations 313 and 311 in figure 7; at station 309 in figure 8; and between stations 313 and 311, 308 and 305, and 305 and 302 in figure 10. Also of note are the apparently weaker frontal zones present during August, 1973 (figure 6) and August, 1974 (figure 11). These apparently weaker frontal zones are the result of more complete mixing of the water mass elements. However, apparently weaker frontal zones also result from sectioning through a frontal zone at some oblique angle or near an edge of the frontal zone and may only be a product of sampling.

It is evident from the examples that frontal zones can separate any combination of sound speed minimums, sound speed maximums, and/or ridge features. The limbs of ridge features could also be considered frontal zones as they too identify water mass boundaries. The variability in the frontal zone dimensions and intensity plus the presence of multiple fronts in a frontal zone are also evident. Other researchers have described frontal zone dimensions varying from 5 km (Miller, 1972) to hundreds of miles (Lafond et al., 1971).

A feature of specific Navy interest is the sharp vertical sound speed gradient evident in the upper 50 to 100 m. This feature varies systematically from month to

month. It appears to approach the surface in August (figures 4, 5, 6, and 11). During the months of October (figure 7), November (figure 8), and December (figure 9), the feature migrates progressively downward. During December (figure 9), its intensity is greatly diminished and it is virtually absent during January (figure 10). This feature is seen world wide. An extensive body of research exists indicating that it is the result of a combination of heat flow across the sea surface and wind induced mixing in the surface layers.

3. Comparison with Water Mass Analysis

To further analyze the use of sound speed as a water mass descriptor, comparisons were made between the results of this study and the work of Lt. R. E. Blumberg (1975). Blumberg, using the same data, delineated water masses by analysis of temperature distribution relative to sigma-t surfaces. In his analysis Blumberg defined northern water as low temperature, low salinity water and southern water as high temperature, high salinity water. The cores of these water masses equate to sound speed minimums and maximums respectively.

Comparisons of sound speed field features and Blumberg's analysis yielded close correspondence in a majority of cases, as illustrated in the following examples. The northern water centered around station 108 and the southern water at station 111 in figure 12 correlate well with the ridge feature centered at station 108 and the dip in isotachs

at station 111 in figure 4. The northern water at station 314 in figure 15 and station 310 in figure 16 show excellent agreement with the ridge feature at station 314 in figure 7 and 310 in figure 8. The southern water at station 315 in figure 17 is in agreement with the dipping isotachs at station 315 in figure 9. The southern water at station 305 and the northern water at station 303 in figure 18 are in excellent agreement with the sound speed maximum and dipping isotachs at station 305 and the ridge feature at station 303 shown in figure 10.

One point of interest that was demonstrated by a comparison of the two studies was the ambiguity in the origins of some sound speed field features. Some are derived from horizontal water mass variability and others arise from vertical motion. An illustration of this is found at stations 306-305 of figure 9 which indicate a sound speed maximum and minimum respectively. Comparison with station 306-305 of figure 17 indicates the feature is the result of vertical motion in the water column and not due to the water mass structure. Vertical motion in figure 17 is indicated by the displacement of the isopycnals and isotherms in step with each other.

4. Spatial and Temporal Relationships

Inspection of the sound speed field revealed systematic relationships among various identifiable features. Comparison of the three lines of stations for August, 1973 (figure 4, 5, and 6) did not show the continuity of any uniquely identifiable

water mass feature through the three sections. This indicated either that the feature's spatial extent was less than the spacing between sections, 10 nm, or that it transited the area at some oblique angle. This last possibility is reinforced by the flow patterns shown by Wickham (1975) and Greer (1975), who described the region's currents using drogue measurements and geostrophy, respectively.

On other vertical cross sections certain similar features appear on succeeding sections. A comparison of the 300 series sections for August, 1973 and August, 1974 (figure 6 and 11), indicated the presence of similar sound speed maximums, indicating a warm more saline water mass, at 400 to 450 meters depth in both sections. The positions of the features differed by 33 km between the two succeeding August sections. The feature in the August, 1974 section also appeared more well developed than its counterpart of the previous year. A comparison of October (figure 7), and November (figure 8), indicated the presence of similar well developed sound speed maximums representing a higher temperature more saline water mass at station 316 in both sections. The feature in the November section appeared to have decreased definition and a greater depth by approximately 100 m than that in the October section. Similar ridge features indicating low temperature lower salinity water also appear in both October and November sections. Their positions vary, with one located at station 314 in the October section and

and the other feature lcoated 22 km east of that position in the November section. The November feature also appears more well developed than its October counterpart. Frontal zones present in both October and November sections also are similar. The frontal zones in the November section are greatly reduced in intensity from the October frontal zones. The position of similar frontal zones also varied between sections by 11 km, being centered at station 311 in October and station 309 in November. A general comparison of October, November, December, January, the 300 series section for August, 1973, and August, 1974 (figures 7, 8, 9, 10, 6, and 11) demonstrates the difficulty of predicting short-term changes. No obvious similarity of features exists between the vertical cross sections for the months of August and October; November and December; and December and January. The pair of vertical cross sections for October and November and for August, 1973 and August, 1974 are the only sections showing obvious similarity of structure.

5. General Comments Concerning the Analysis of Sound Speed Features

In concluding the discussion of the analysis of the sound speed fields, it is appropriate to make a few general comments pertaining to the overall analysis. First, visual scanning indicates that sound speed fields define the "character" of the water mass more sharply than does the temperature or salinity alone. "Character" refers to the shape, definition of the core and extent of the water mass.

Water mass elements which are small in spatial extent and have a definite shape and a well defined core region are illustrated at station 316 in figure 7 and at station 305 in figure 10. Water mass structures which are large in extent, have less well defined cores or cores below 500 meters, and lack definite shape are illustrated at station 310 in figure 8, station 316 in figure 9, and station 315 in figure 10. The extent of mixing is also evidenced by variations in the character of the water mass structure, variations in the slopes of the isotachs, and the overall complexity of the sound speed field. The loss of the 1487 m/sec isotach in the core region at station 316 from October to November (figure 7 and 8), a reduction in the core definition, an overall lessening of isotach slopes, and a reduction in the complexity of the sound speed field over the two months illustrate this.

Several comments pertaining to the problems of acoustic propagation are also appropriate. Since the sound speed field is the controlling factor in the propagation of acoustic energy, its complex structure is significant. Sound speed minimums tend to channel acoustic energy decreasing transmission loss locally. Several poorly defined sound speed minimums are illustrated at station 110 and at station 108 in figure 4, and throughout the vertical dimension of the ridge feature at station 310 in figure 8. Lafond and Lafond (1971) found much more pronounced minimums, in terms of temperature, in their analysis of the California front.

Sound speed maximums, on the other hand, cause local divergence of acoustic energy. Well defined examples of sound speed maximums are illustrated at station 316 in figure 7 and station 305 in figure 10. It is apparent that the sound speed field in this region is very complex and attempts to describe it would require numerous samples of the vertical sound speed profile at suitable intervals in time and space.

B. CROSS-CORRELATION FUNCTIONS AND COEFFICIENTS

1. Description of Method

Cross-correlation functions and cross-correlation coefficients were computed to provide a more objective measure of the small scale sound speed field variability, including characteristic "correlation lengths". Two different methods of analysis were employed, one involving sound speed, the other its gradient.

One method utilized the sound speed gradient averaged over 2 m or 10 m intervals to derive a cross-correlation function (Rxy). As defined in Bendat and Piersol (1971),

$$Rxy = \frac{1}{N} \sum_{n=1}^{N} x_n y_n$$

where N is the total number of depth data points; n refers to a specific depth data point; and x and y are sound speed gradients at depth n and station X and Y, respectively. The two stations are separated by some horizontal distance from

0 to 16 station intervals. Space lag in depth (n) is zero in all cases. The use of the sound speed gradient

$$g_i = \frac{(V_i - V_{i+1})}{(Z_i - Z_{i+1})}$$

where g_i is sound speed gradient, and V_i and V_{i+1} are sound speeds at depths Z_i and Z_{i+1} respectively, had the same effect as using a high pass filter. Smaller scale variations in the sound speed profile were emphasized and larger scale variations were de-emphasized. Rxy provides a numerical value representing the small scale similarity in shape between the sound speed profiles at stations X and Y.

The other method treated detrended sound speed values at 2 m depth increments to determine a cross-correlation coefficient RHOxy. As defined by Bendat and Piersol (1971)

$$\text{RHOxy} = \frac{1}{N} \frac{\sum_{n=1}^{N} (x_n-\bar{x})(y_n-\bar{y})}{\sqrt{\frac{1}{N}\sum_{n=1}^{N} (x_n-\bar{x})^2 \frac{1}{N}\sum_{n=1}^{N} (y_n-\bar{y})^2}}$$

where N is the total number of depth data points; n is a specific depth data point; x and y are detrended sound speed values at depth n and stations X and Y respectively, separated by some horizontal distance from 0 to 16 station intervals; and $\bar{x}$ and $\bar{y}$ are the means of the detrended sound speed values at station X and Y respectively. Detrending was accomplished using the relation

$$v(n,X) = V(n,X) - \frac{1}{NSTA} \sum_{i=1}^{NSTA} V_i(n)$$

where v(n,X) is the detrended sound speed value at a specified depth n and station X; V(n,X) is the sound speed value at depth n and station X; and the last term is the mean value $\overline{V}$ computed at a given depth n from the sound speed values V_i at each station i=1 to NSTA inclusive. Detrending also produced the effect of a high pass filter. Again detrending emphasized small scale variations and de-emphasized large scale variations. In this example comparing the results from using the sound speed gradient and the results from using the detrended sound speed values would be equivalent to comparing the output of two high pass filters with the latter having a lower cutoff frequency. Both methods emphasize small scale variations but, between the two methods, detrending emphasizes larger scale variations. RHOxy gives a numerical value between -1 and +1 representing the small scale similarity between the shapes of the sound speed profiles at station X and Y. Normalization allows meaningful comparisons between RHOxy values determined different stations and months.

Results are displayed utilizing two different methods. In one method, Rxy and RHOxy are plotted as a function of distance between station X and station Y. A reference station (Y) is designated and identified along the Y axis of each graph. RHOxy and Rxy are then plotted at the correlated

station on the X axis. Each figure contains eight graphs, one on top of the other. Scales, with values ranging from .001 sec^{-1} to .03 sec^{-1}, are not indicated on the graphs of Rxy since their purpose is to show relative values of the cross-correlation function between adjacent stations. Values of RHOxy vary from -1 to +1 as indicated. Graphs of Rxy and RHOxy are shown as figures 19 through 22 and figures 23 through 28 respectively.

Another method is also used to display the cross-correlation coefficients, RHOxy. An n x n matrix of the cross-correlation coefficients, RHOxy, is established with each RHOxy being computed from a specified station X and station Y as indicated. Contours of equal cross-correlation coefficient are constructed and the resulting fields appear in figures 29 through 31. A maximum value of unity appears along the diagonal of the resulting field, with symmetry about the diagonal.

2. Results of Cross-Correlation Determinations

The cross-correlation functions derived from the sound speed gradients averaged over 2 meter depth increments for the month of October, 1973 were computed. The results are shown in figures 19 and 20. These cross-correlation functions were characterized by small correlation even between adjacent stations. The cross-correlation function was also computed from sound speed gradients averaged over 10 meter depth increments for October, 1973. The results are shown as

figures 21 and 22. A comparison of the two cross-correlation functions derived from the sound speed gradients at 2 meter increments and 10 meter increments respectively indicated that better correlation existed between stations when sound speed gradients were averaged over 10 meter increments. This would be expected since the larger averaging distance would smooth out much of the variability due to small vertical motions.

The cross-correlation coefficients derived from the detrended sound speed values were computed for the months of October, 1973, January, 1974, and August, 1974. The results are shown as figures 23 through 28. A comparison of these results and figures 7, 10, and 11 respectively indicated a high correlation between features in the sound speed field and variations in the cross-correlation coefficient. Of particular interest was the correlation at fronts where cross-correlation coefficients varied from plus values through zero to negative values in the distance of three stations, 16.5 km, or less. The algebraic difference in the cross-correlation coefficients over this distance exceeded one frequently.

Overall the correlation of adjacent stations is small. In most cases the cross-correlation coefficients dropped to 0.5 or less within a distance of two stations from the reference. The region of highest correlation appeared to be between station 303 and station 307 during October (figures 23, 24 and 29).

Correlation length, as defined here, is the distance between successive maximums of the cross-correlation coefficient. This parameter specifies the distance between stations having similar characteristics on the vertical scale of two meters or so. Correlation lengths were on the order of five to seven station intervals, 27.5 km to 38.5 km, during August, 1974. Correlation lengths for January, 1974 were quite variable ranging from a distance of 5 stations, 27.5 km to 10 stations, 55 km.

IV. CONCLUSIONS

A. DISCUSSION

This discussion has addressed the problems of horizontal sound speed variability. This was accomplished through subjective analysis of the sound speed field and through computation of cross-correlation functions and cross-correlation coefficients of sound speed gradients and detrended sound speed values respectively, for stations along a vertical cross section. The results, indicating a complex picture of sound speed variability as a function of both time and space, are of interest and concern to physical oceanographers and specifically to naval oceanographers.

Physical oceanographers, it has been shown, can use sound speed as a descriptor of water masses. Its use enhances differences between water masses as compared to the use of salinity or temperature alone where changes in salinity and temperature between water masses are of the same sign. For this reason sound speed permits high resolution in defining the structure of water masses.

The naval oceanographer is interested in sound speed as an oceanographic variable which is the controlling factor in the propagation of acoustic energy. The complex sound speed fields in this study area result in equally complex fields of locally varying acoustic intensity. The nature of the effect of the sound speed field on the propagation of acoustic

energy depends on the frequency of the acoustic energy. For frequencies such that the wavelength is much less than the scale of the sound speed field feature, refraction occurs in a predictable manner which is not dependent on frequency. For frequencies whose wavelengths are on the order of the size of the sound speed field feature or larger, scattering occurs as a function of frequency. This would mean, for sound speed field features on the scale of two meters, that scattering becomes important near the frequency

$$f = \frac{C}{L} = \frac{1500 \text{ m/sec}}{2 \text{ m}} = 750 \text{ Hz}$$

and, for sound speed field features on the scale of 10 meters, at the frequency

$$f = \frac{C}{L} = \frac{1500 \text{ m/sec}}{10 \text{ m}} = 150 \text{ Hz}$$

where f is the frequency, C is sound speed and L is wavelength.

It is apparent that the influence of complex sound speed fields, like those treated in this thesis, on acoustic propagation should be studied. A first step in such a study would be an objective description of the environment. This thesis provides such a description. First, for vertical scales of variability greater than 10 meters, it was demonstrated by visual analysis of the sound speed field that the horizontal extent of such features was, in some cases, less

than 11 km. Second, for scales of vertical variability between 2 and 10 meters, it was demonstrated by the weak correlation between adjacent stations that the horizontal extent of these features was again less than 11 km when the variability was integrated over the entire sound speed profile. The correlation length provided a measure of how often sound speed profiles similar on the variability scale of 2 to 10 meters repeated themselves. Correlation lengths on the order of three to five station intervals (16.5 km to 27.5 km) were predominant.

B. POSSIBLE FUTURE ANALYSIS

The application of other analysis techniques to the present data is suggested. One such technique is to lag the cross-correlation coefficient in the depth direction to investigate the effect of internal wave activity. Another is calculation of the cross-correlation coefficients over smaller segments of the sound speed profile, as opposed to correlation over the entire depth range, to localize the centers of variability or homogeneity. A third variation would be to compute the cross-correlation coefficients over several different vertical sampling intervals of depth, in addition to the 2 and 10 meter intervals used here, to study the cross-correlation coefficient as a function of the variability scale. Future research projects might include extension of the present area of study to include stations further east and west; occupying stations at time intervals of a few days or a week to describe short term temporal variations; and sampling at shorter horizontal intervals.

APPENDIX A

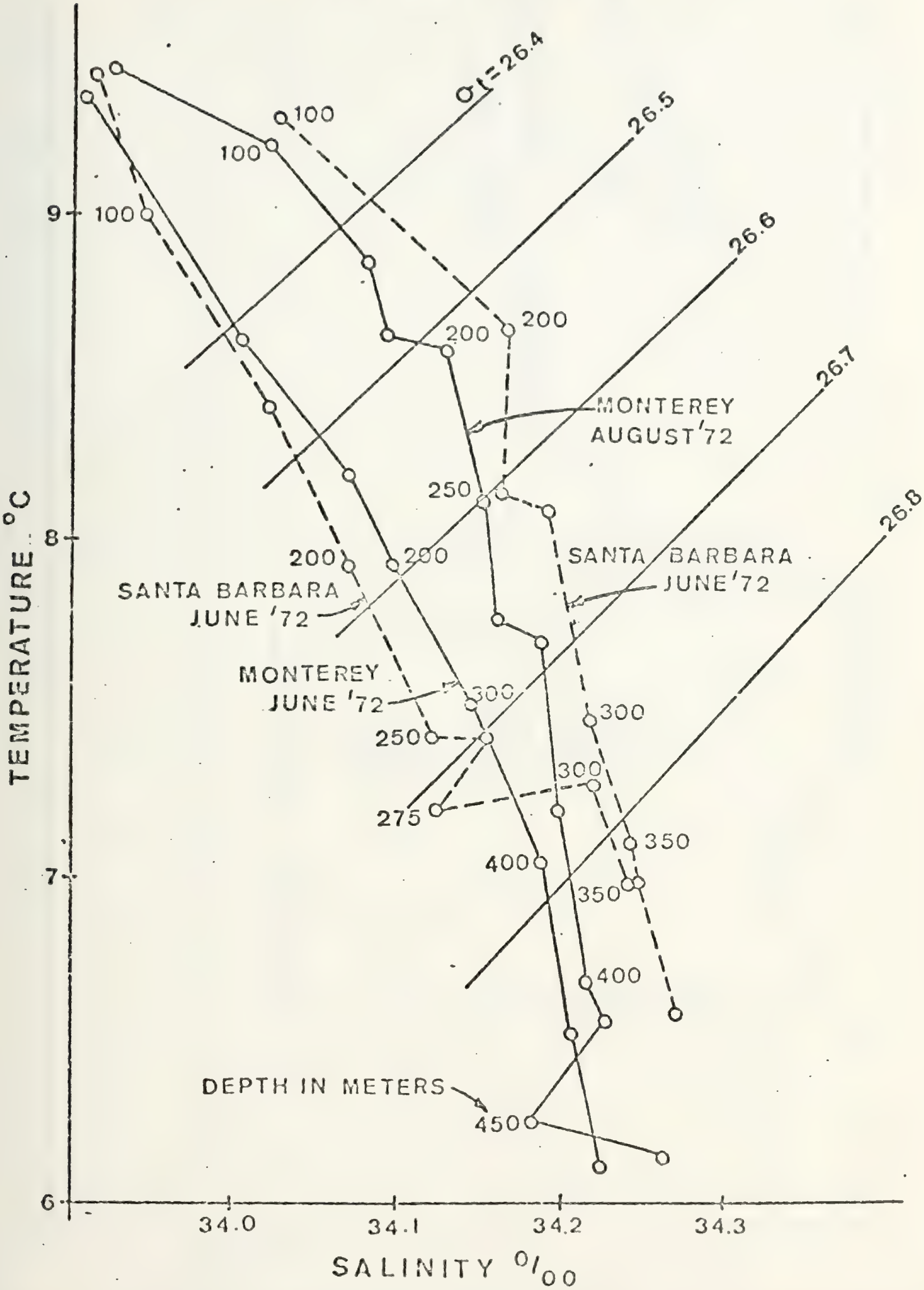

Figure 1. Typical T-S relations in the study area (from Wickham,1975).

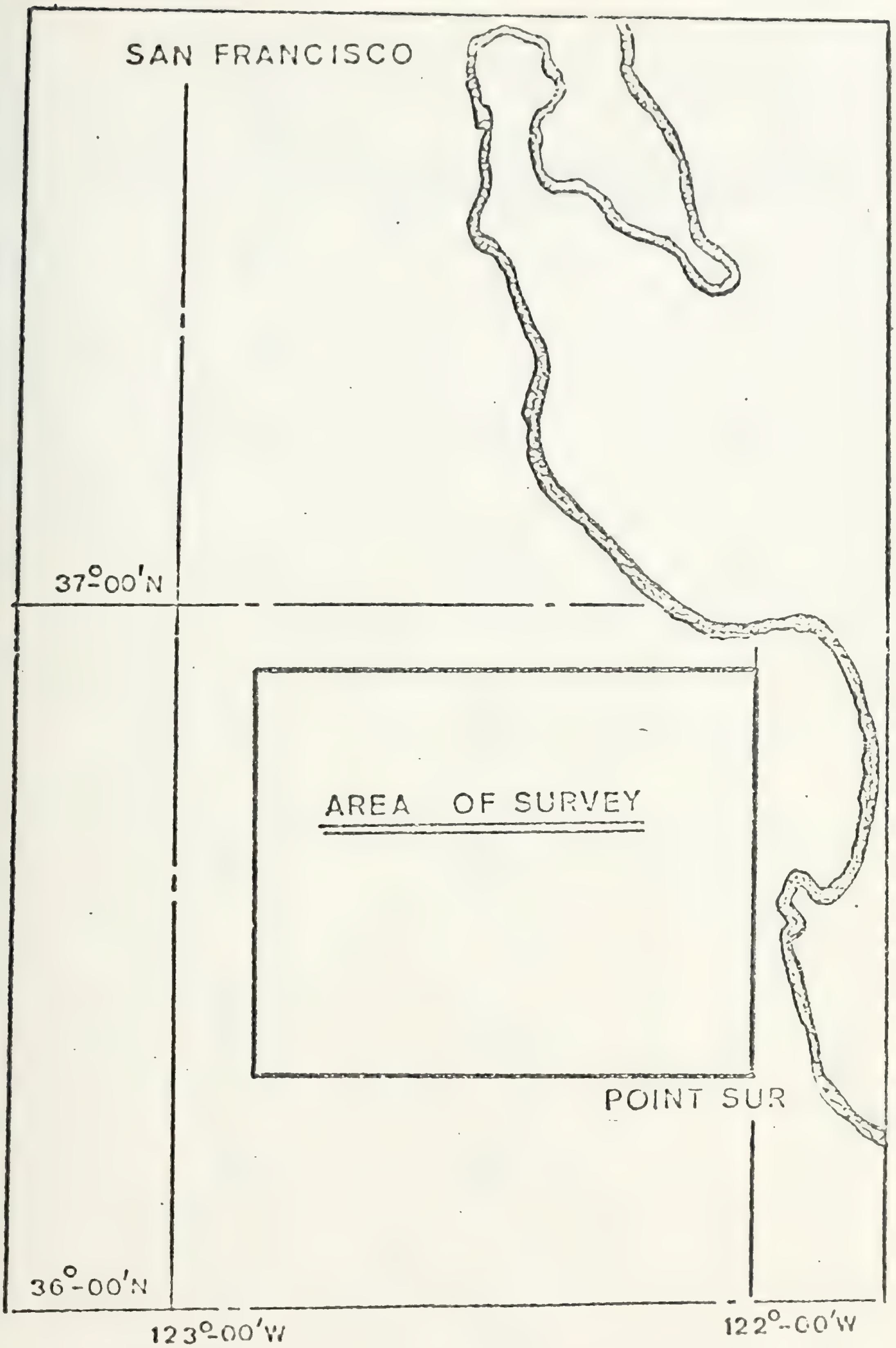

Figure 2. Area of Survey (After Wickham,1975)

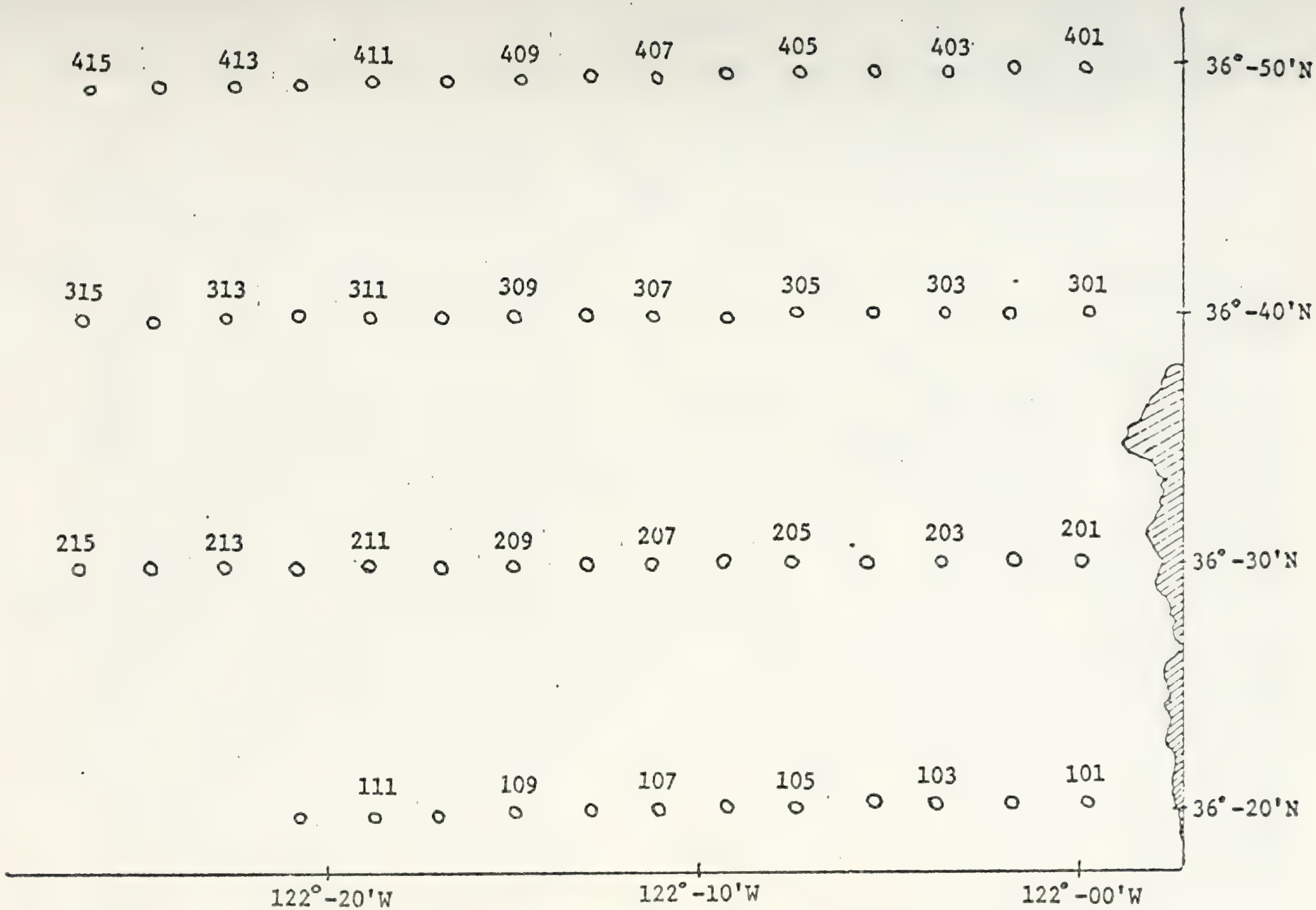

Figure 3. Station Locations (After Wickham,1975).

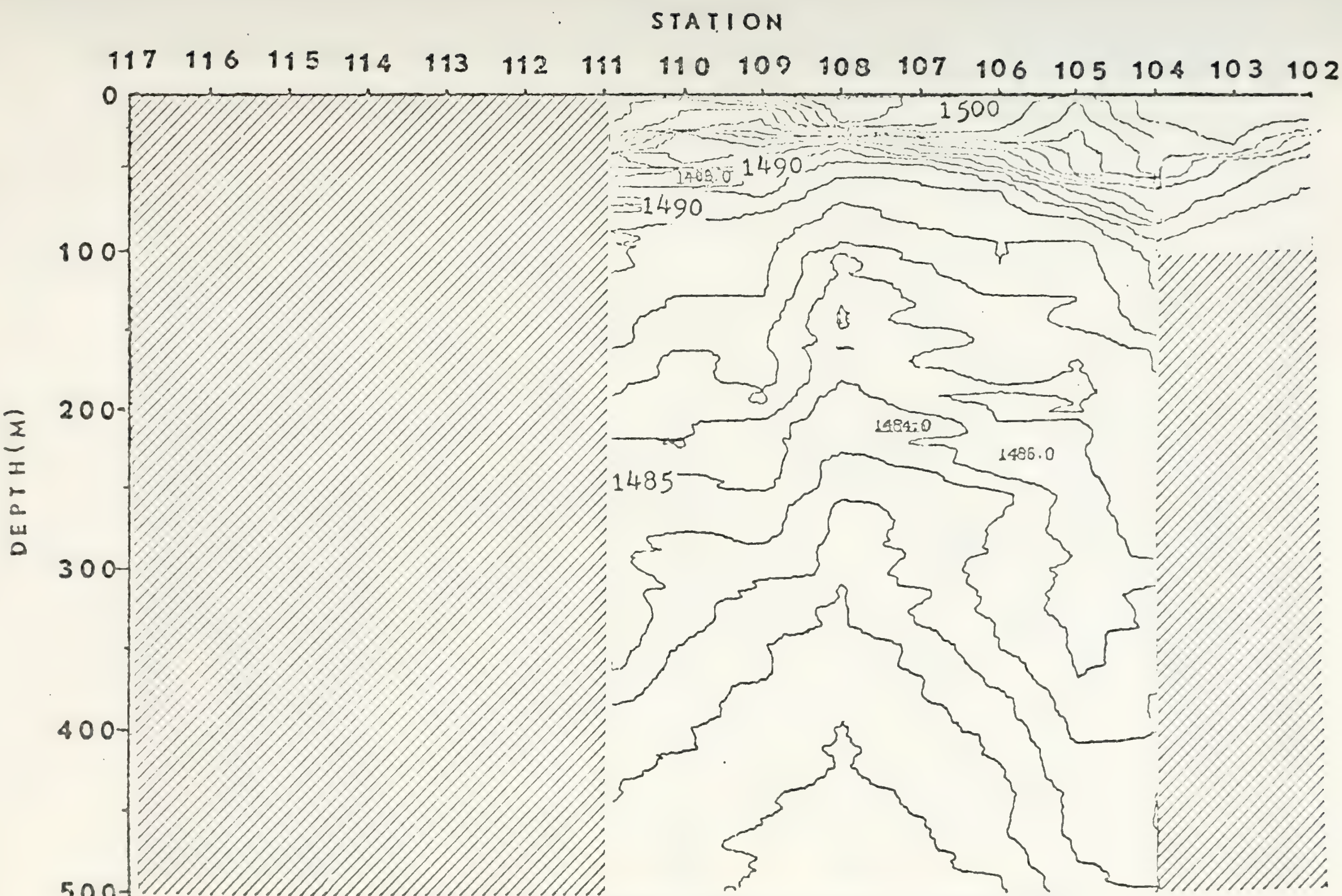

Figure 4. Sound speed field in m/sec for August, 1973.

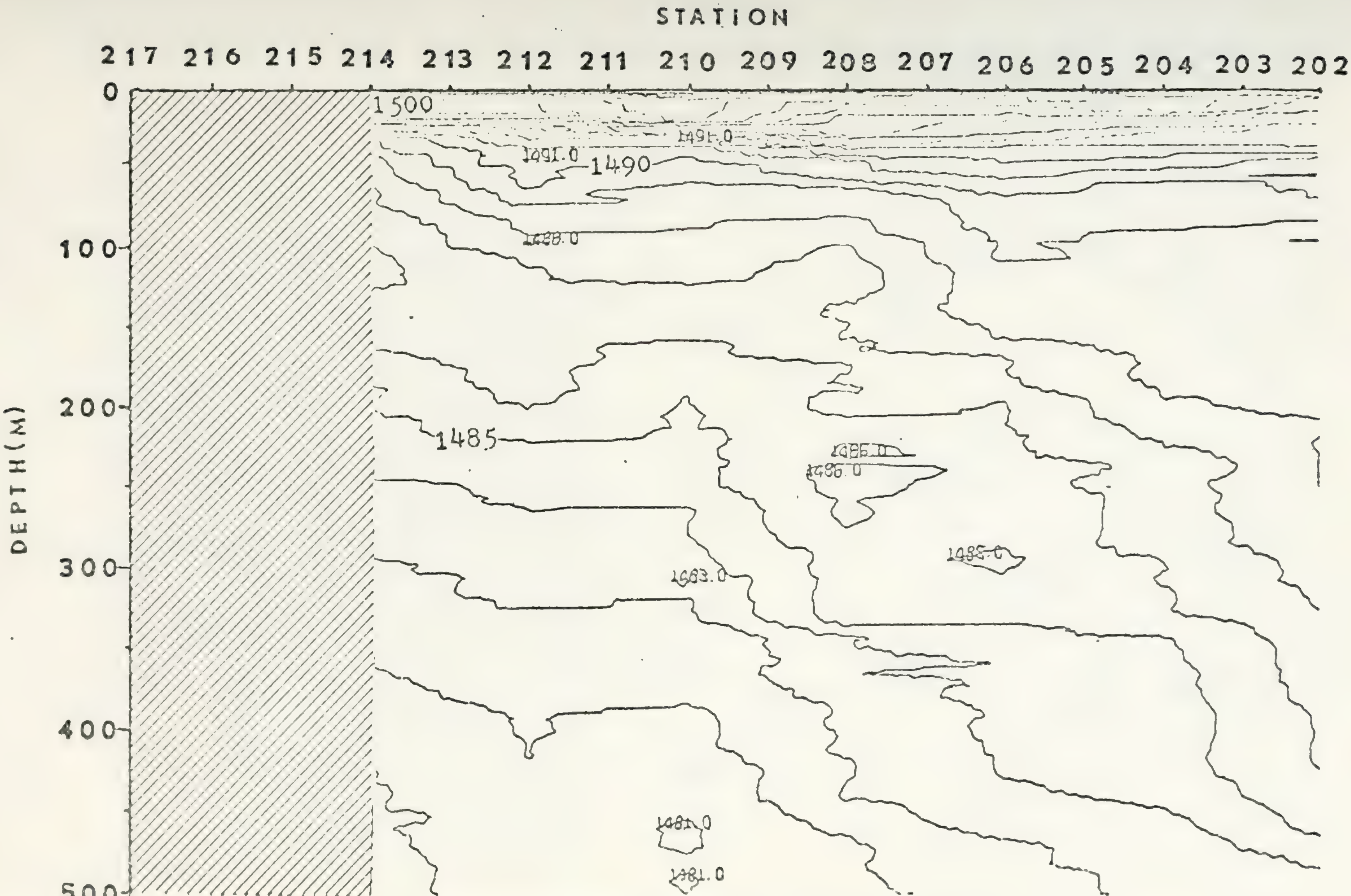

Figure 5. Sound speed field in m/sec for August, 1973.

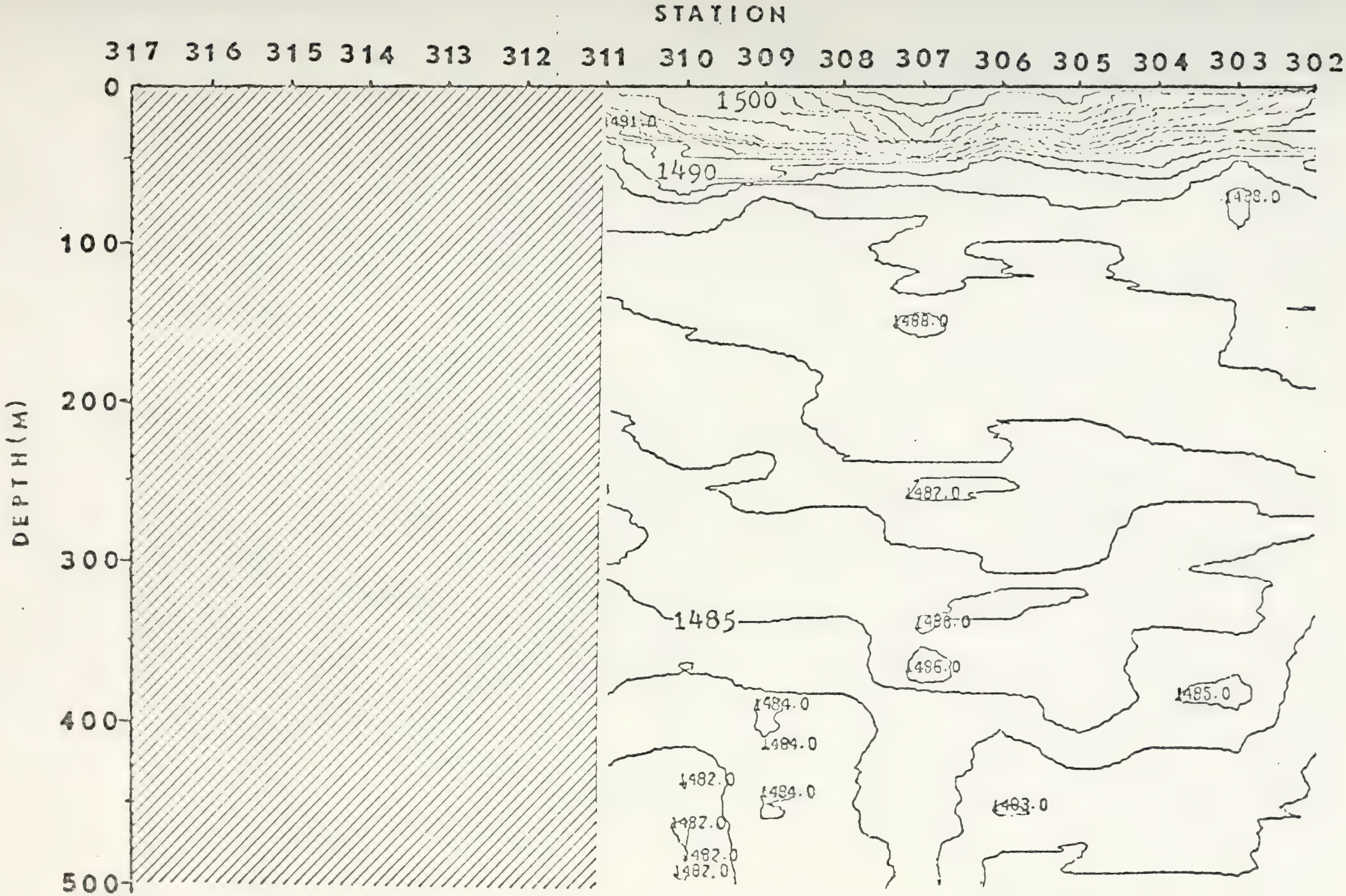

Figure 6. Sound speed field in m/sec for August, 1973.

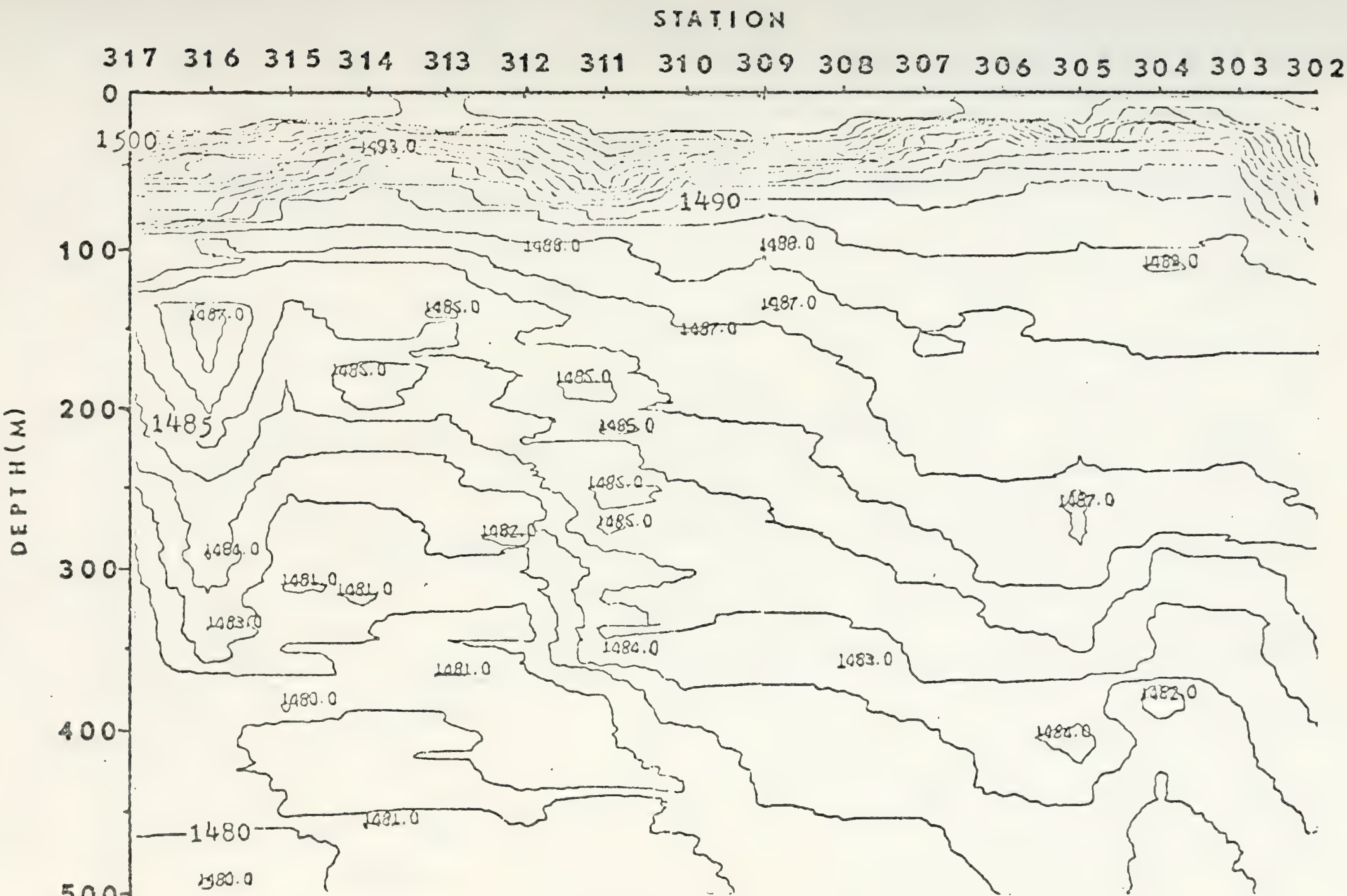

Figure 7. Sound speed field in m/sec for October, 1973.

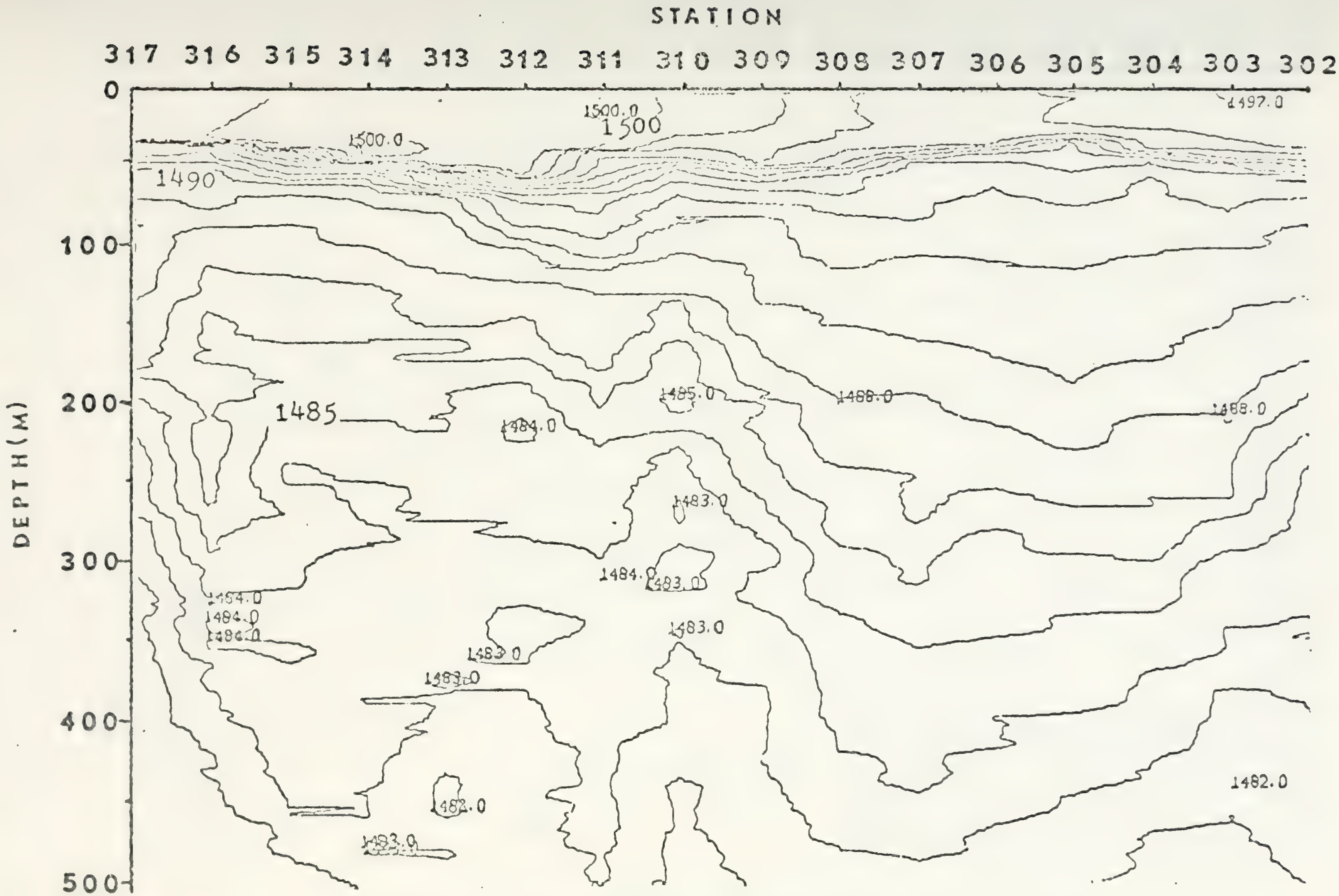

Figure 8. Sound speed field in m/sec for November, 1973.

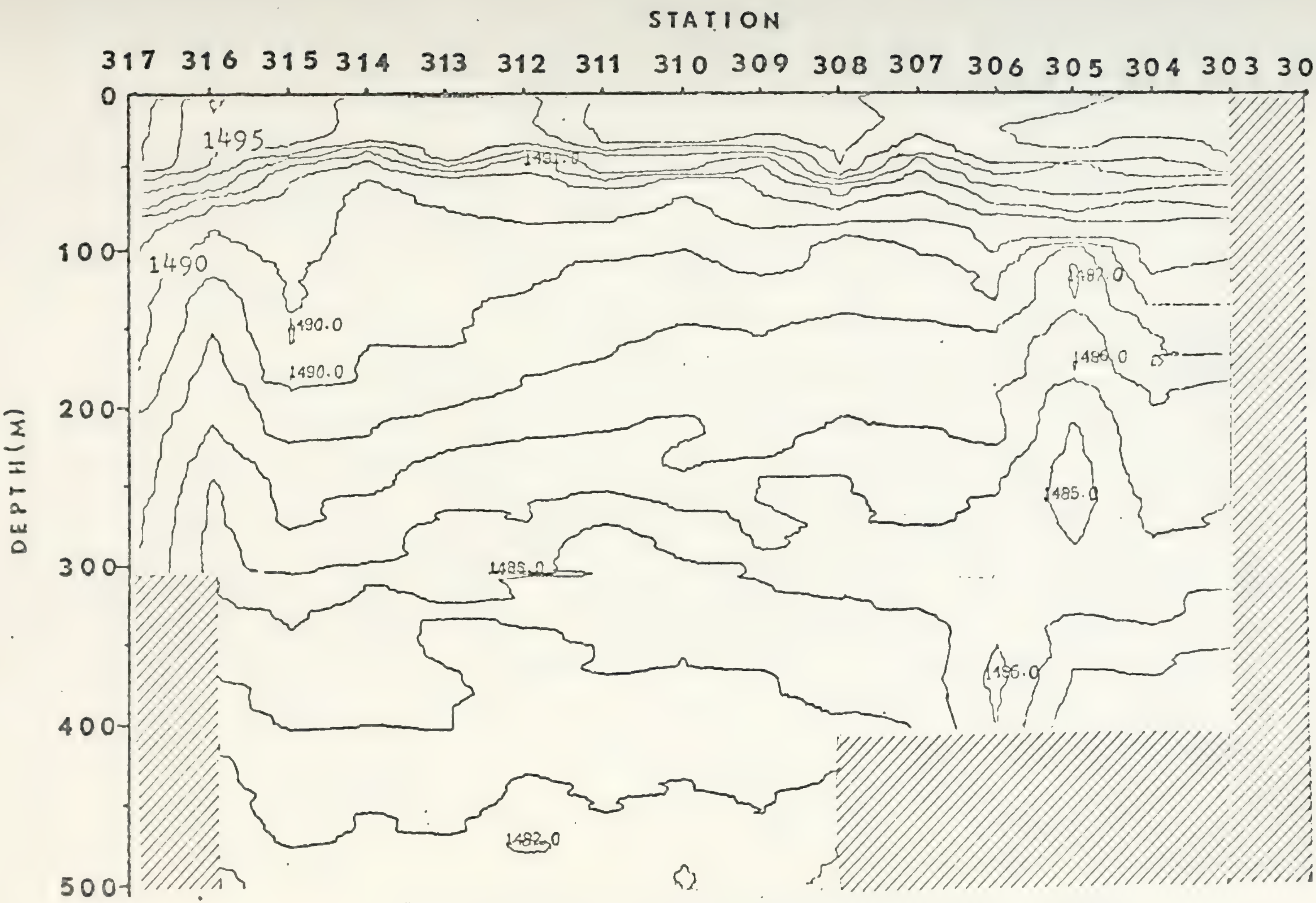

Figure 9. Sound speed field in m/sec for December, 1973.

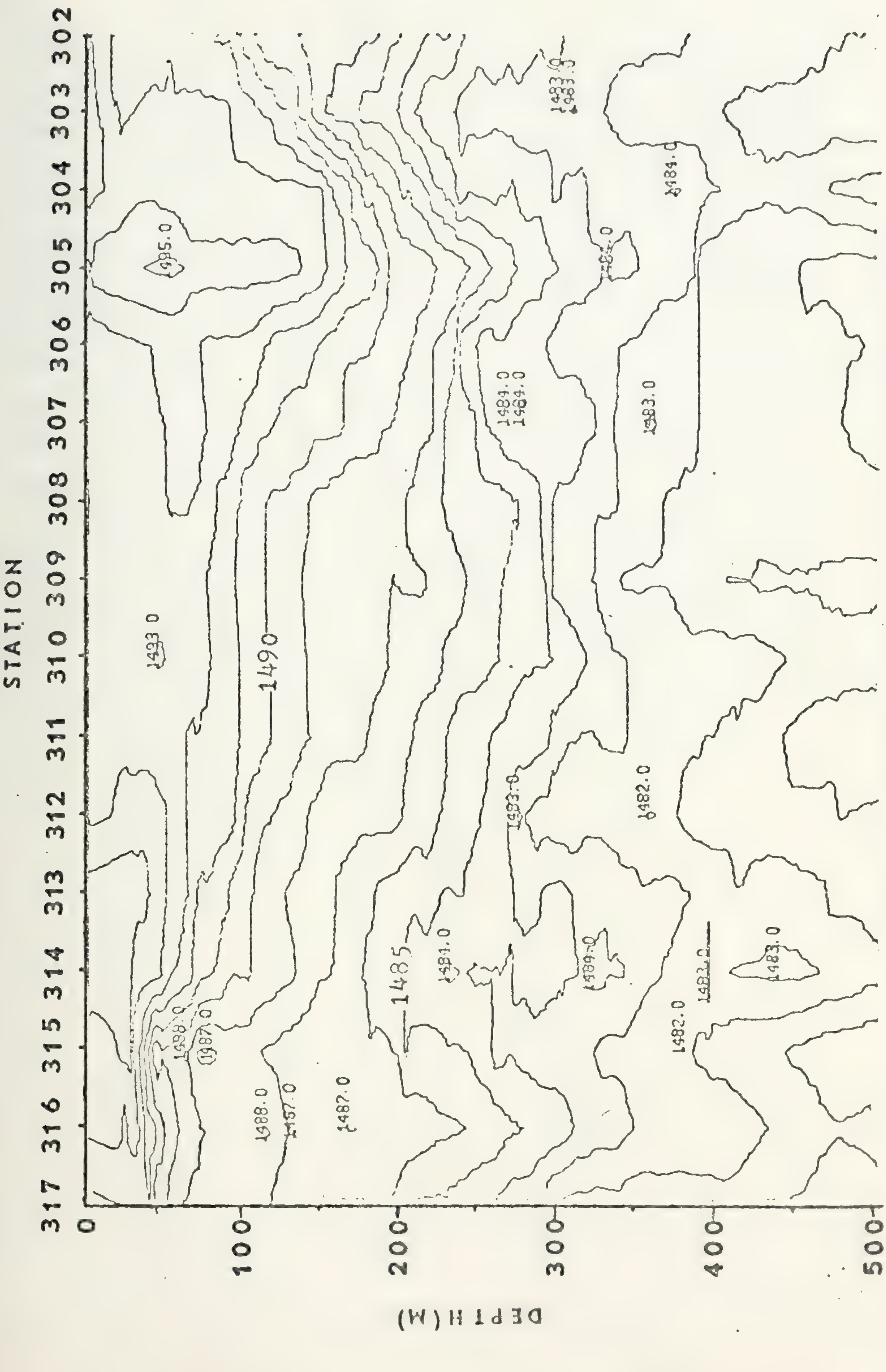

Figure 10. Sound speed field in m/sec for January, 1974.

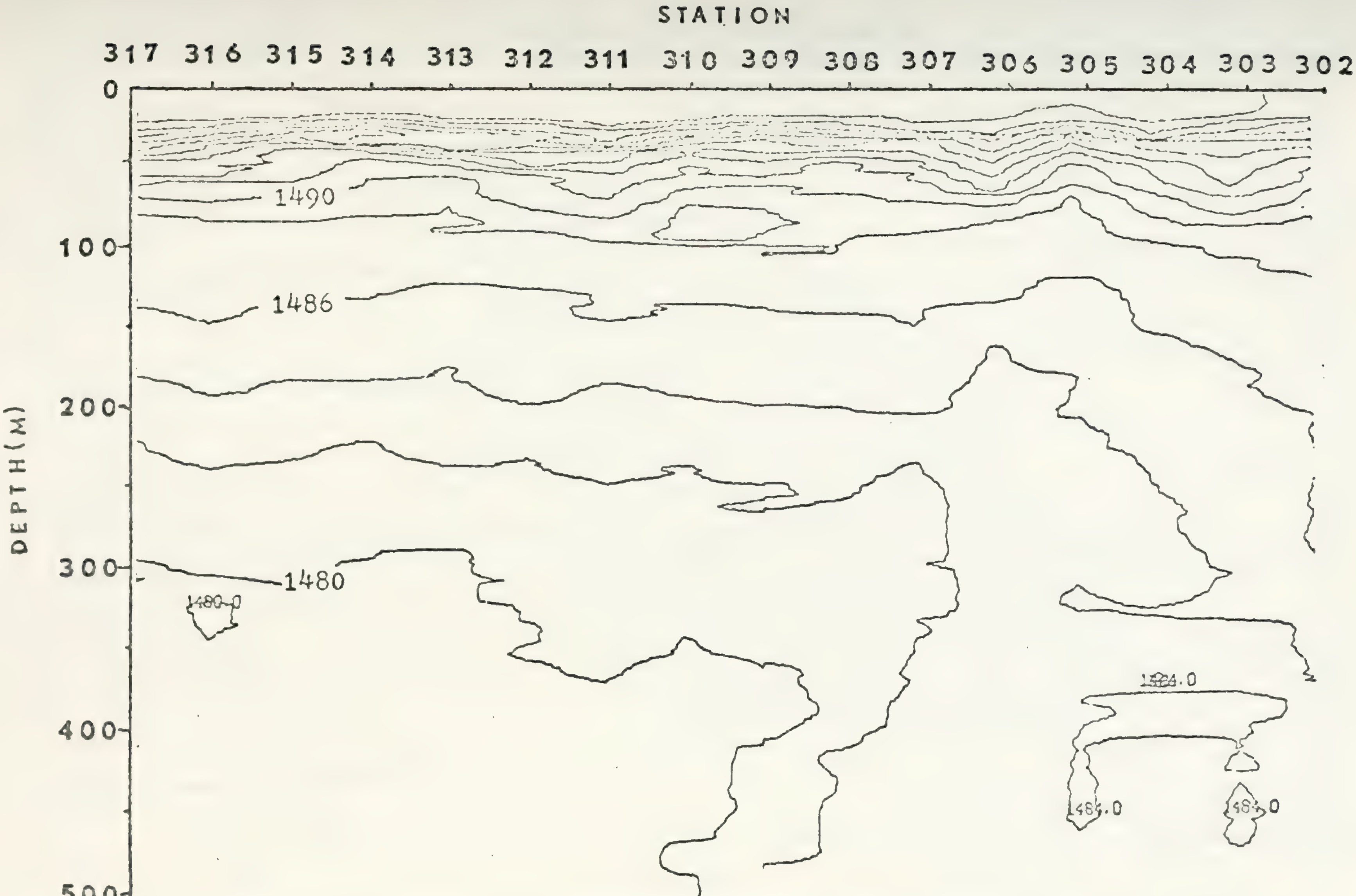

Figure 11. Sound speed field in m/sec for August, 1974.

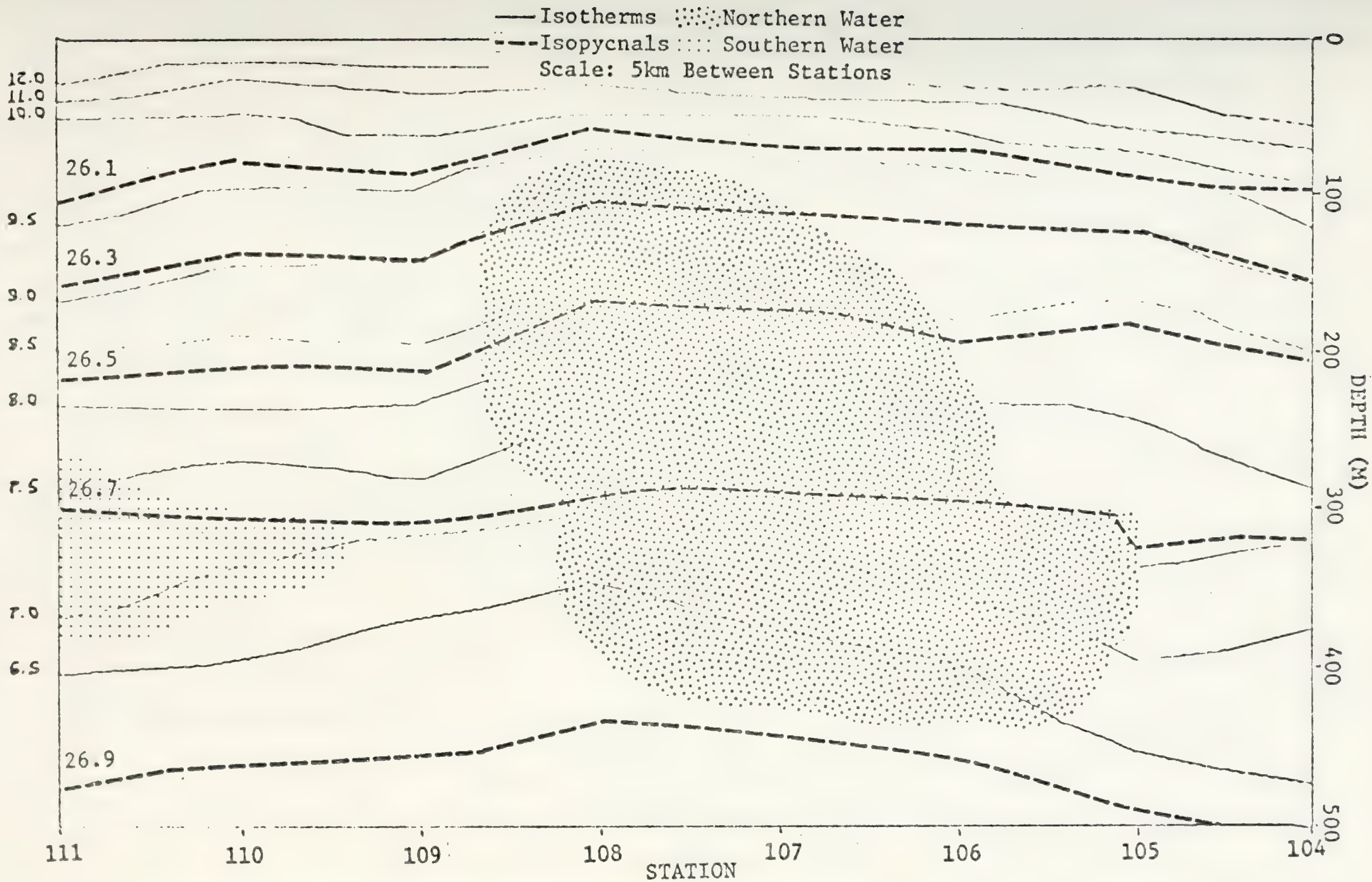

Figure 12. Isotherms and constant sigma-t surfaces, August, 1973 (from Blumberg,1975).

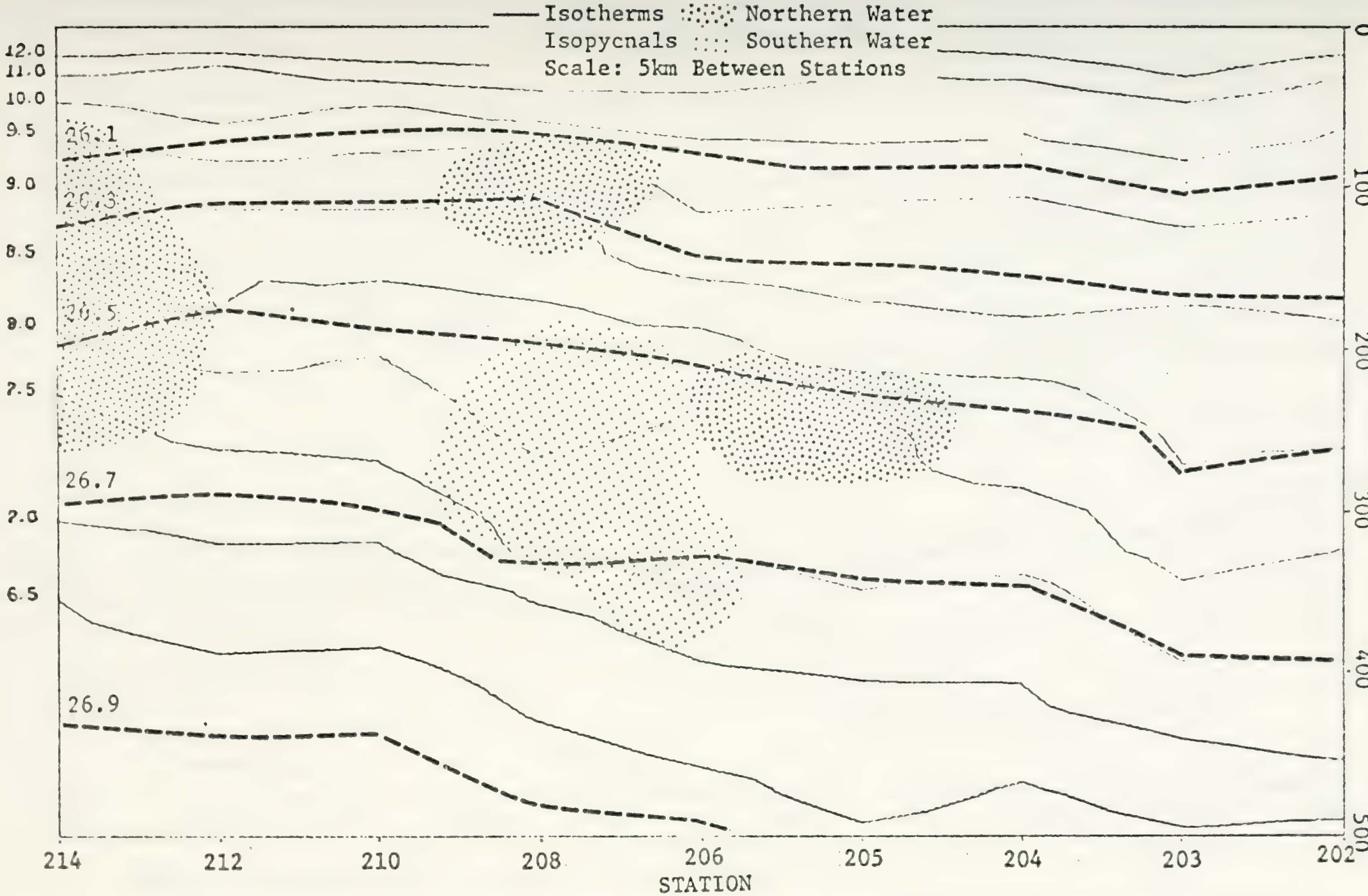

Figure 13. Isotherms and constant sigma-t surfaces, August, 1973 (from Blumberg,1975).

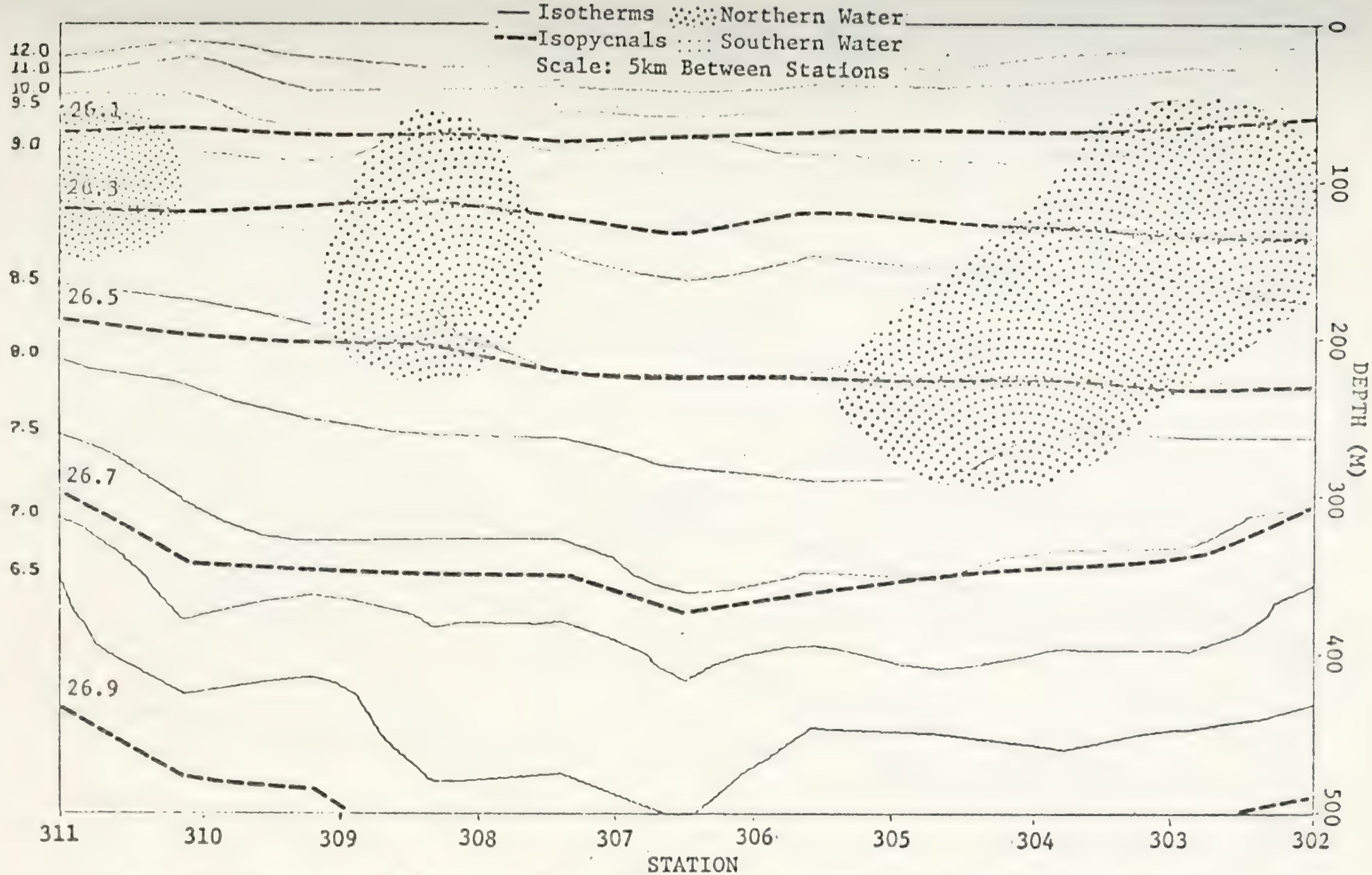

Figure 14. Isotherms and constant sigma-t surfacos, August, 1973 (from Blumberg,1975).

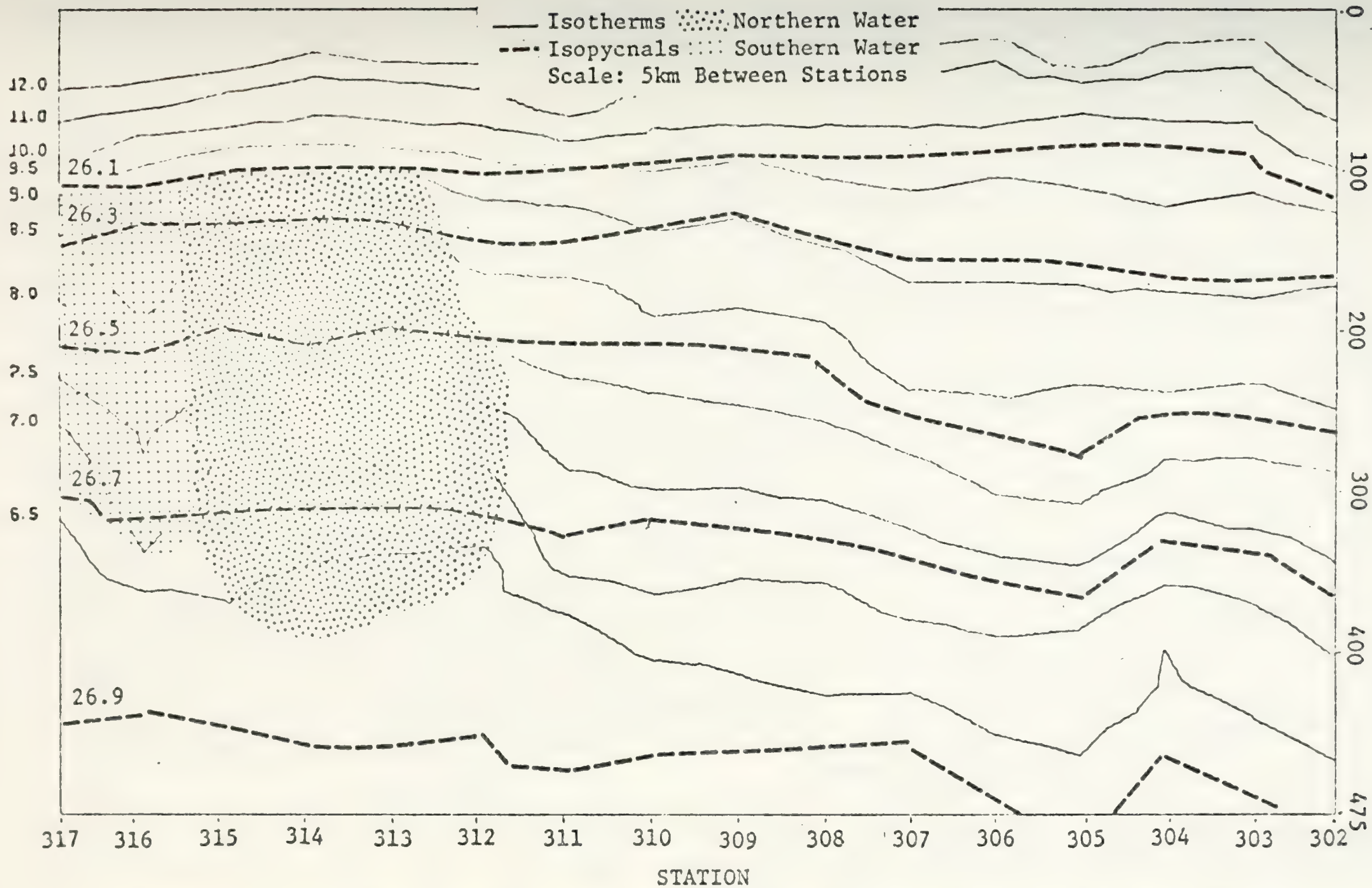

Figure 15. Isotherms and constant sigma-t surfaces, October, 1973 (from Blumberg,1975).

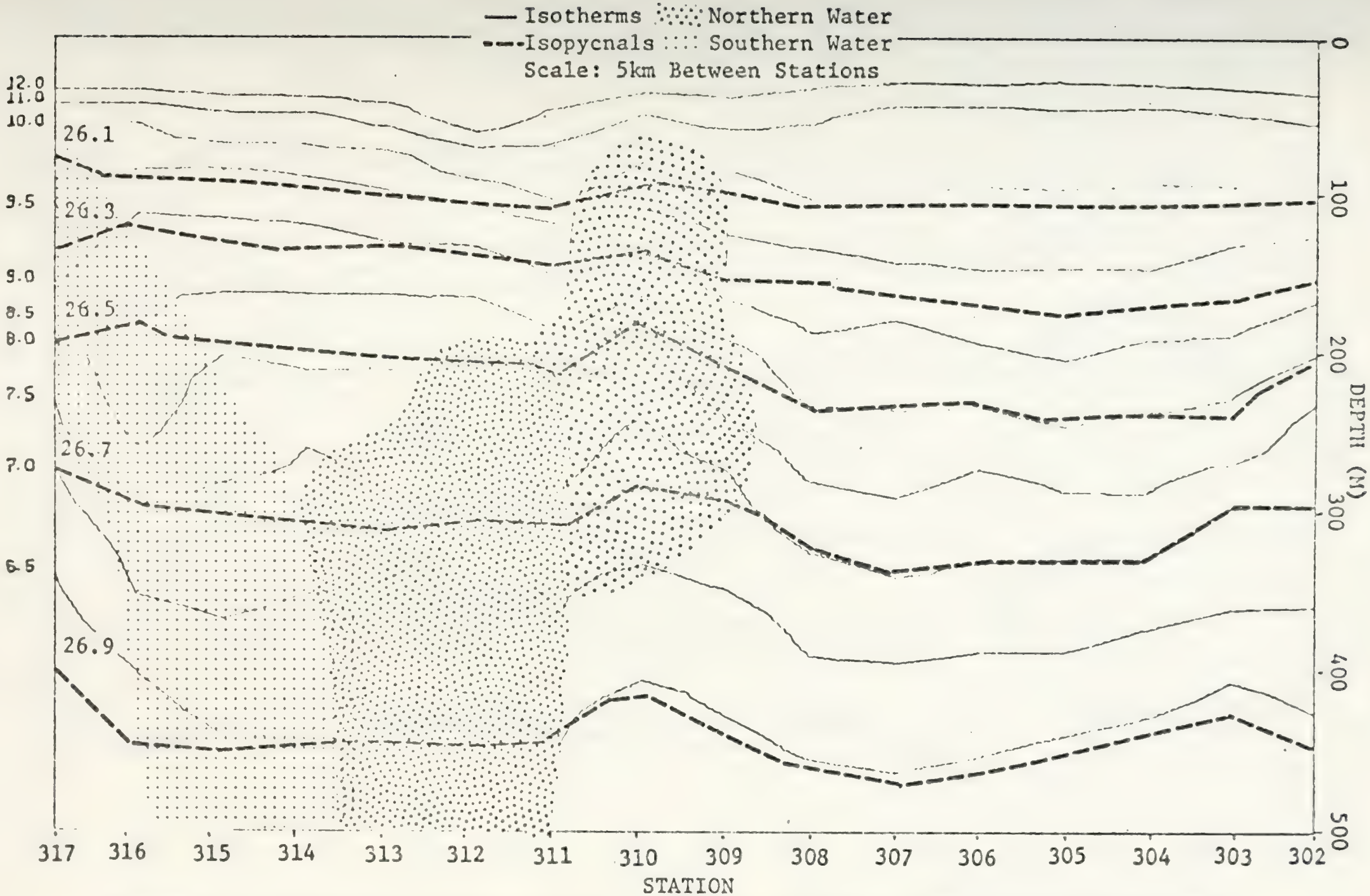

Figure 16. Isotherms and constant sigma-t surfaces, November, 1973 (from Blumberg,1975).

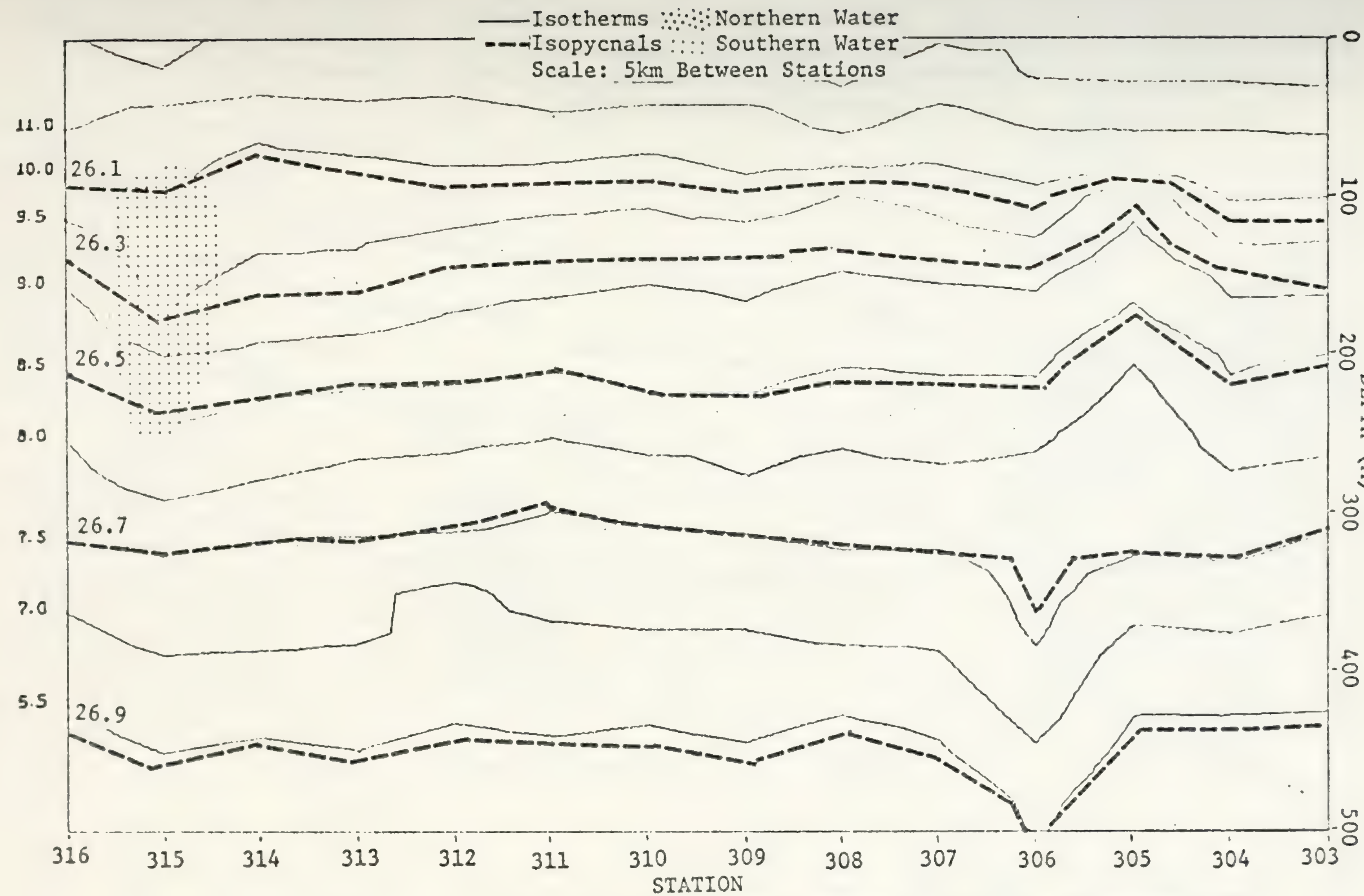

Figure 17. Isotherms and constant sigma-t surfaces, December, 1973 (from Blumberg,1975).

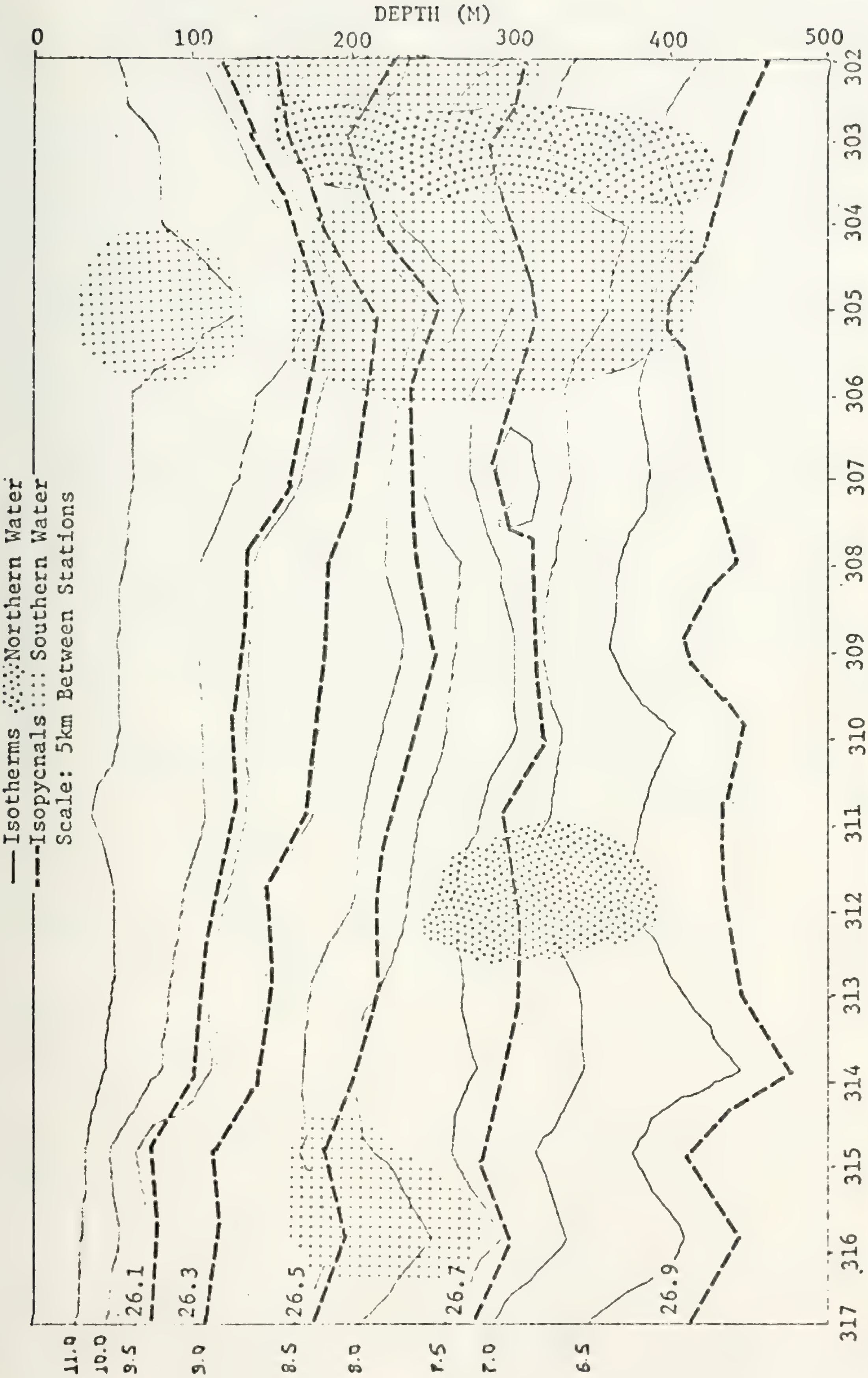

Figure 18. Isotherms and constant sigma-t surfaces, January, 1974 (from Blumberg,1975).

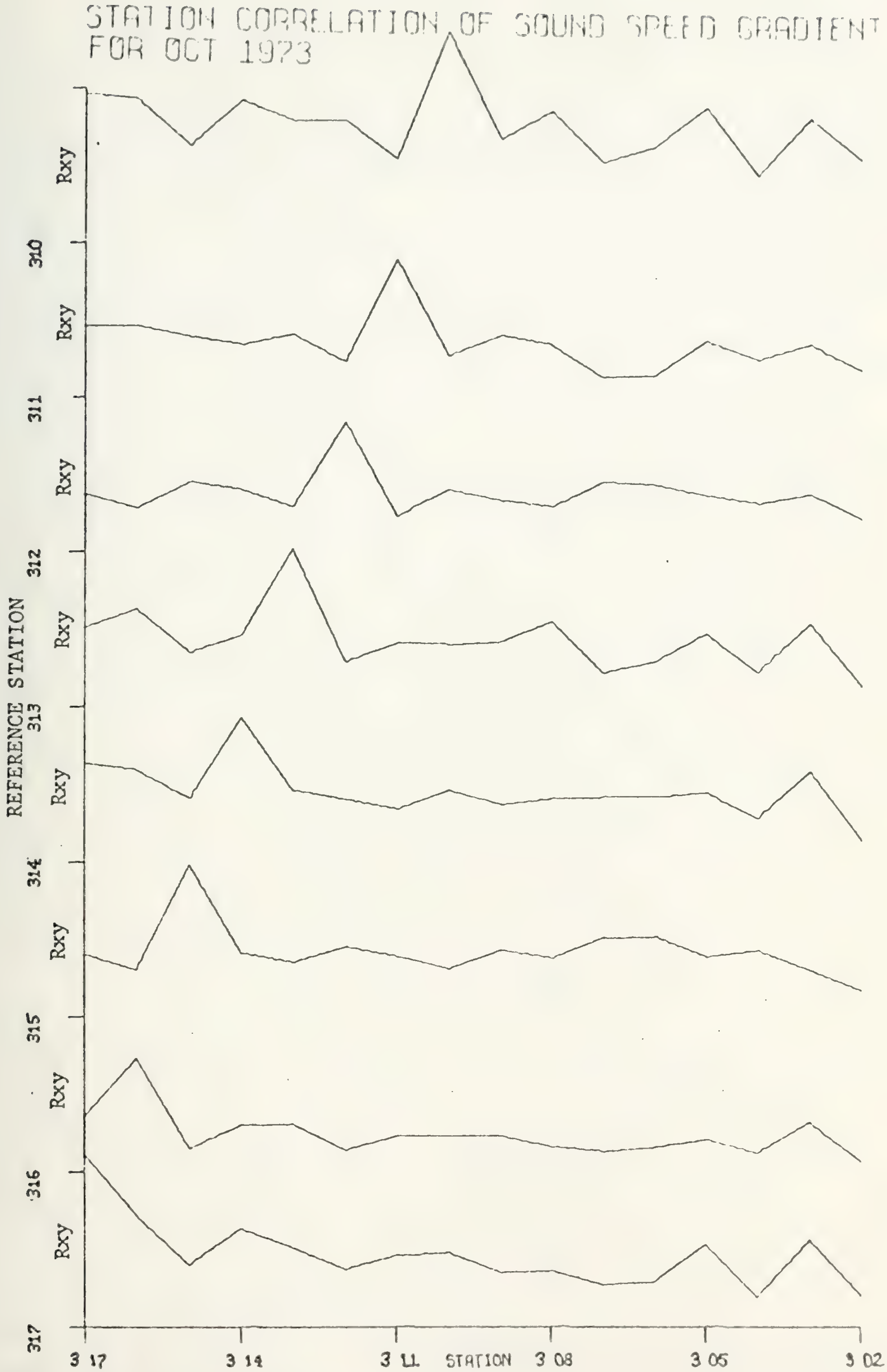

Figure 19. Rxy by station. (Gradients averaged over 2 m intervals)

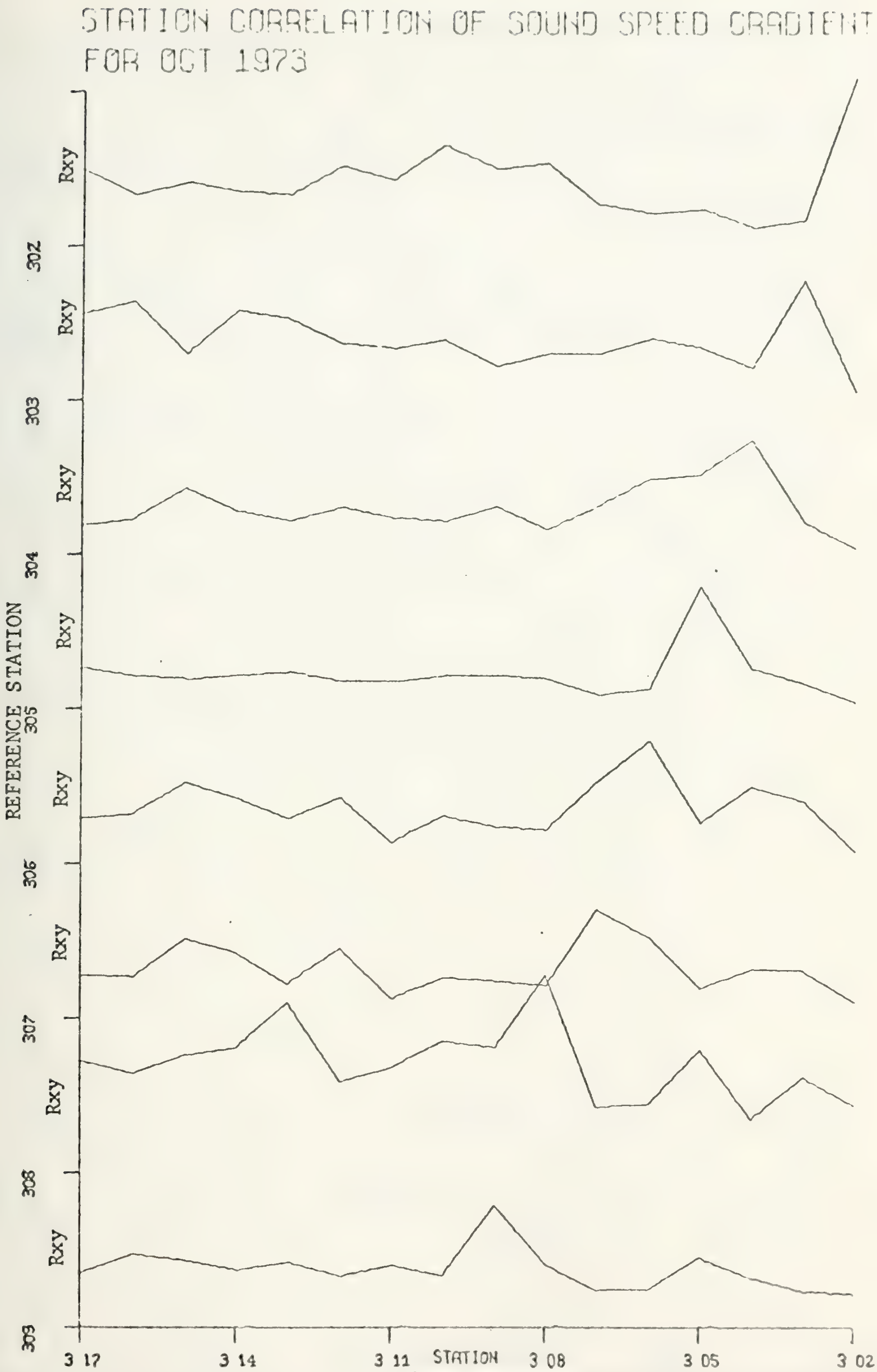

Figure 20. Rxy by station. (Gradients averaged over 2 m intervals)

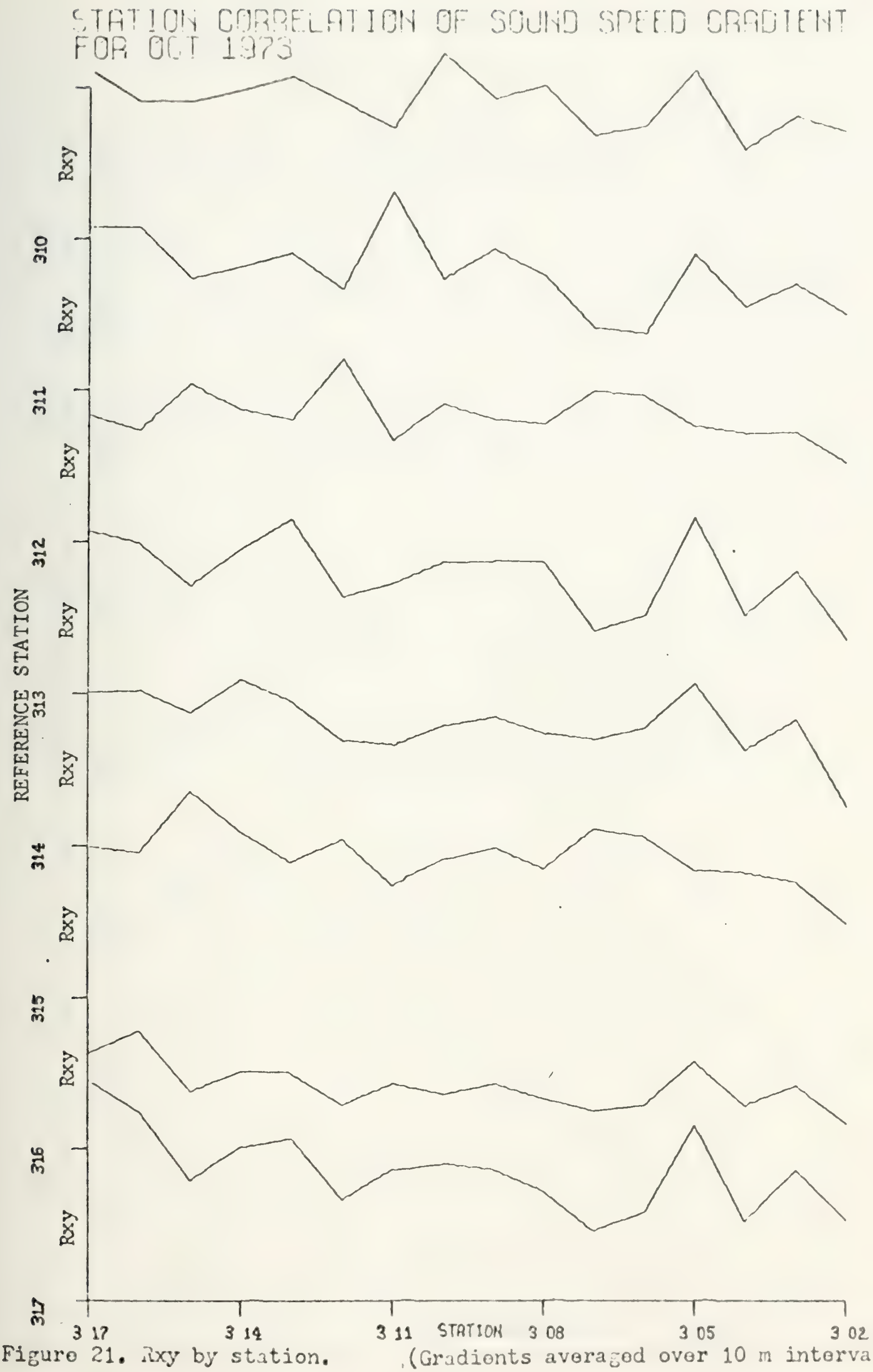

Figure 21. Rxy by station. (Gradients averaged over 10 m intervals)

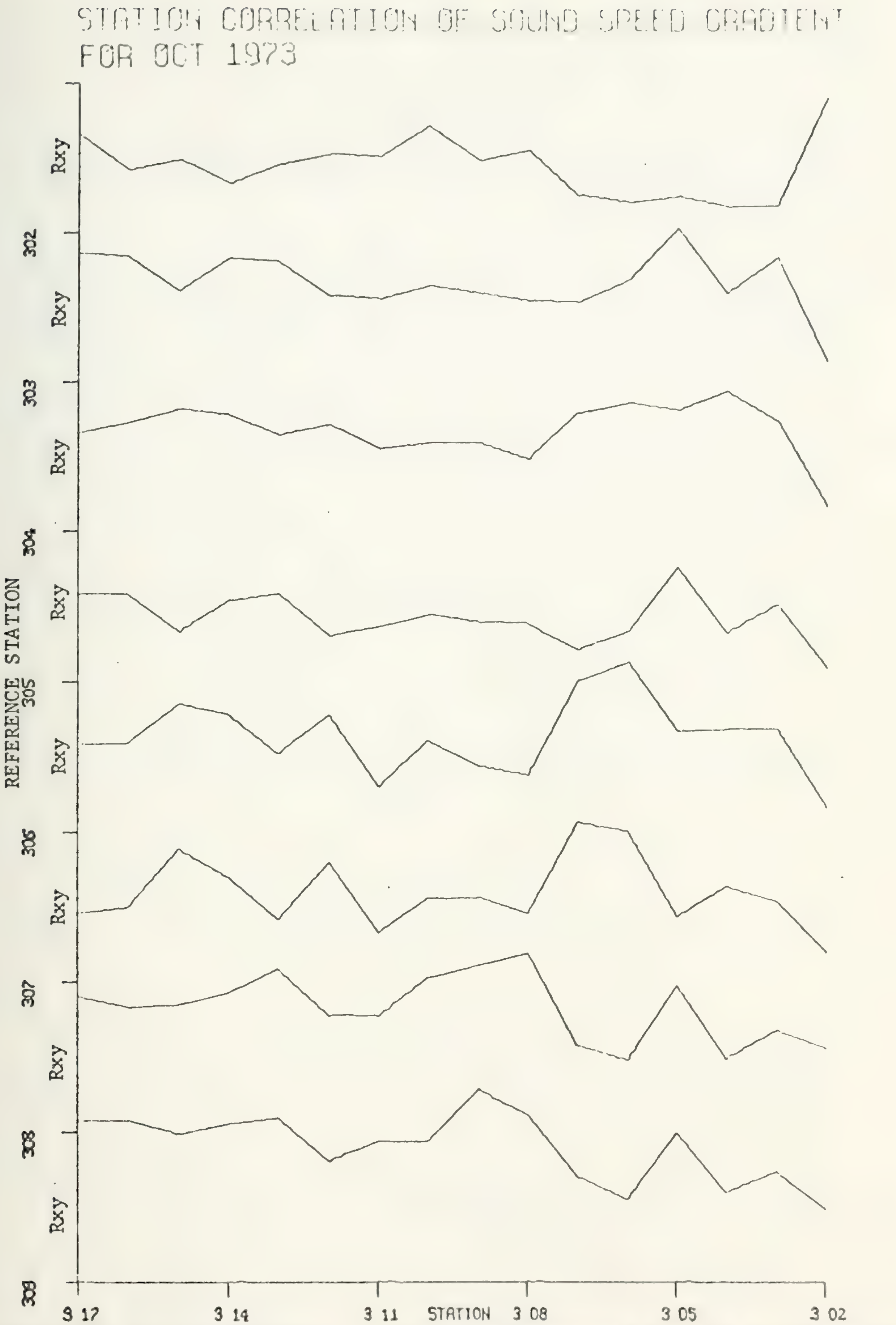

Figure 22. Rxy by station. (Gradients averaged over 10 m intervals)

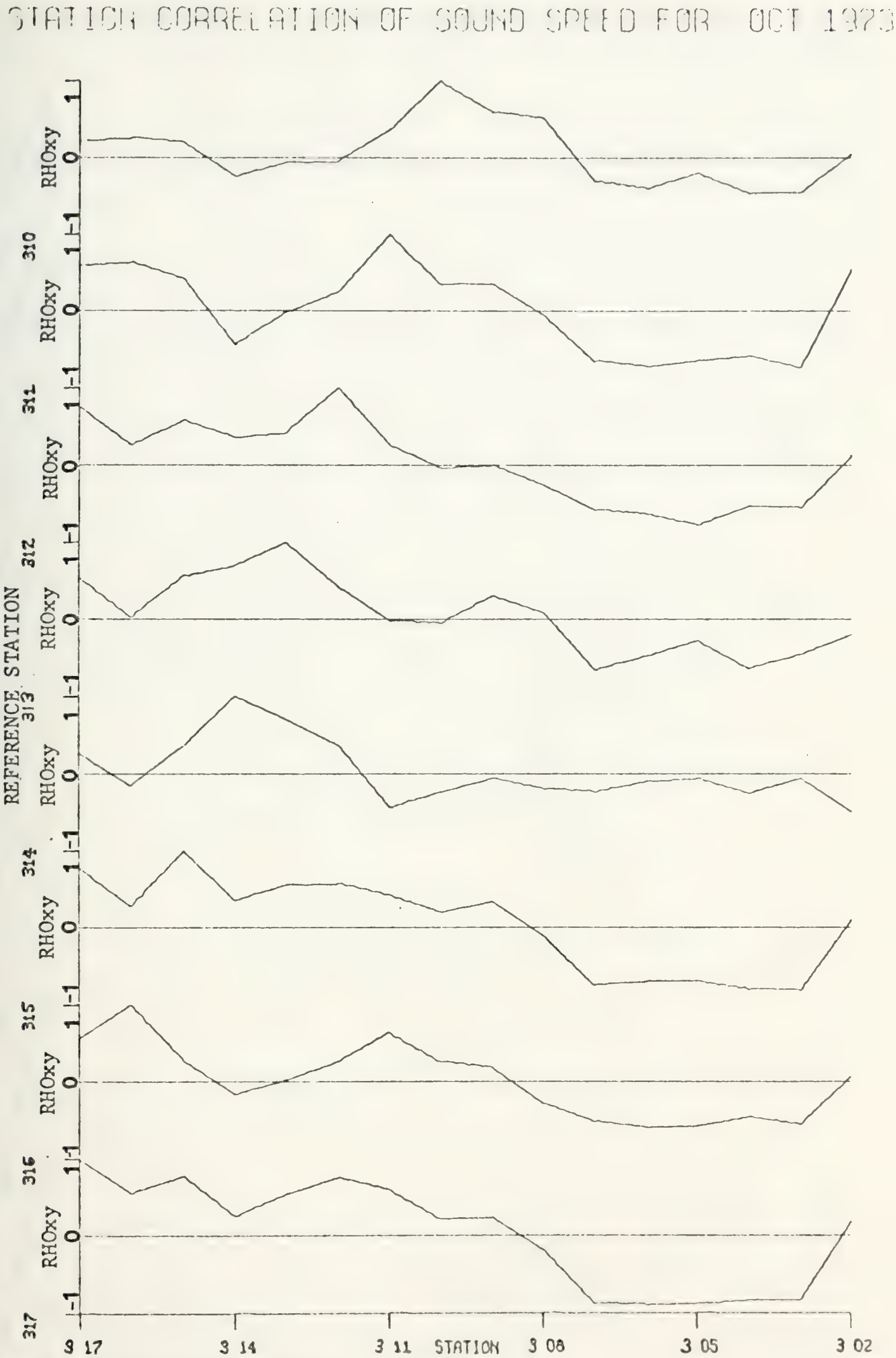

Figure 23. RHOxy by station.

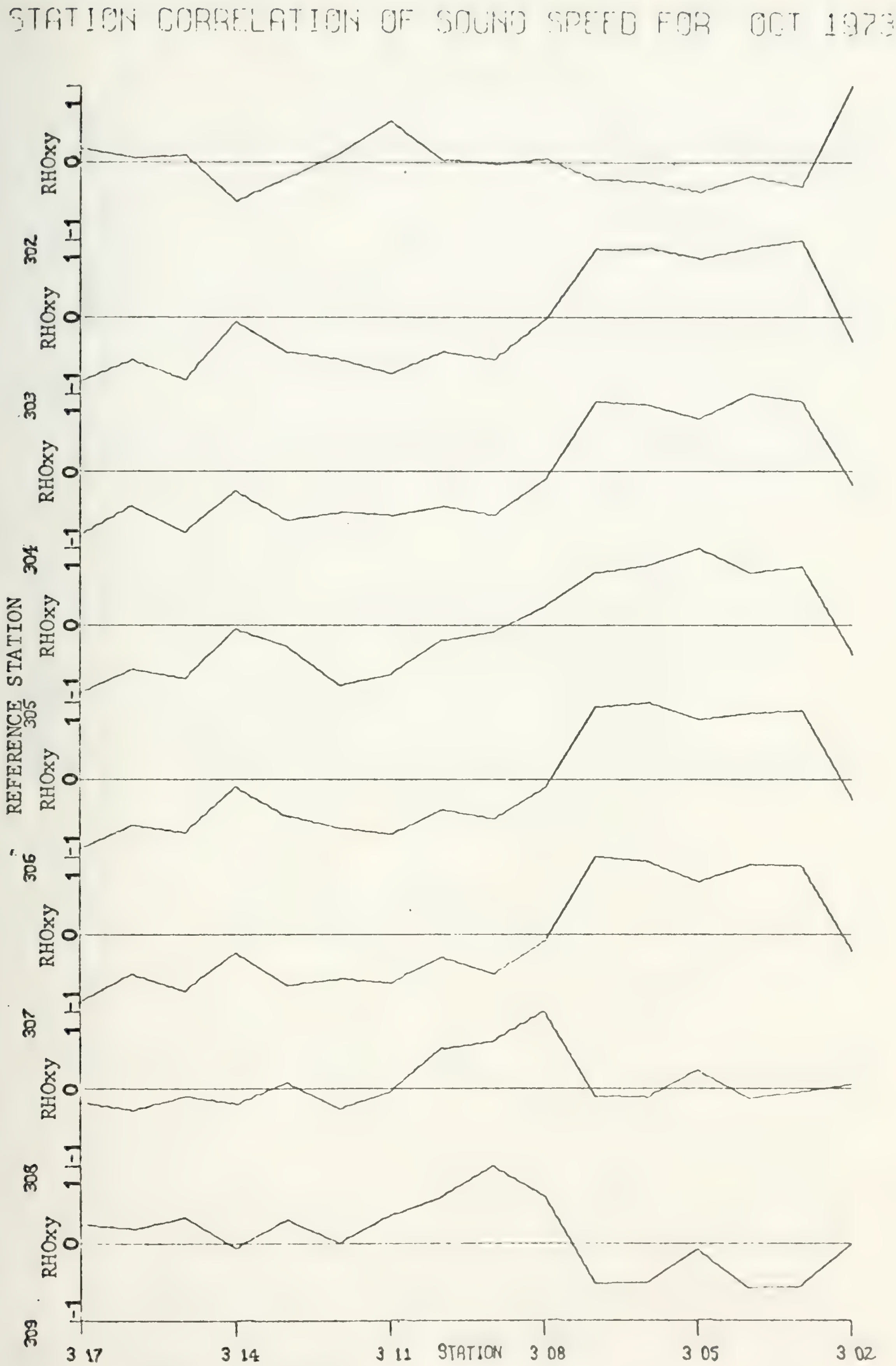

Figure 24. RHOxy by station.

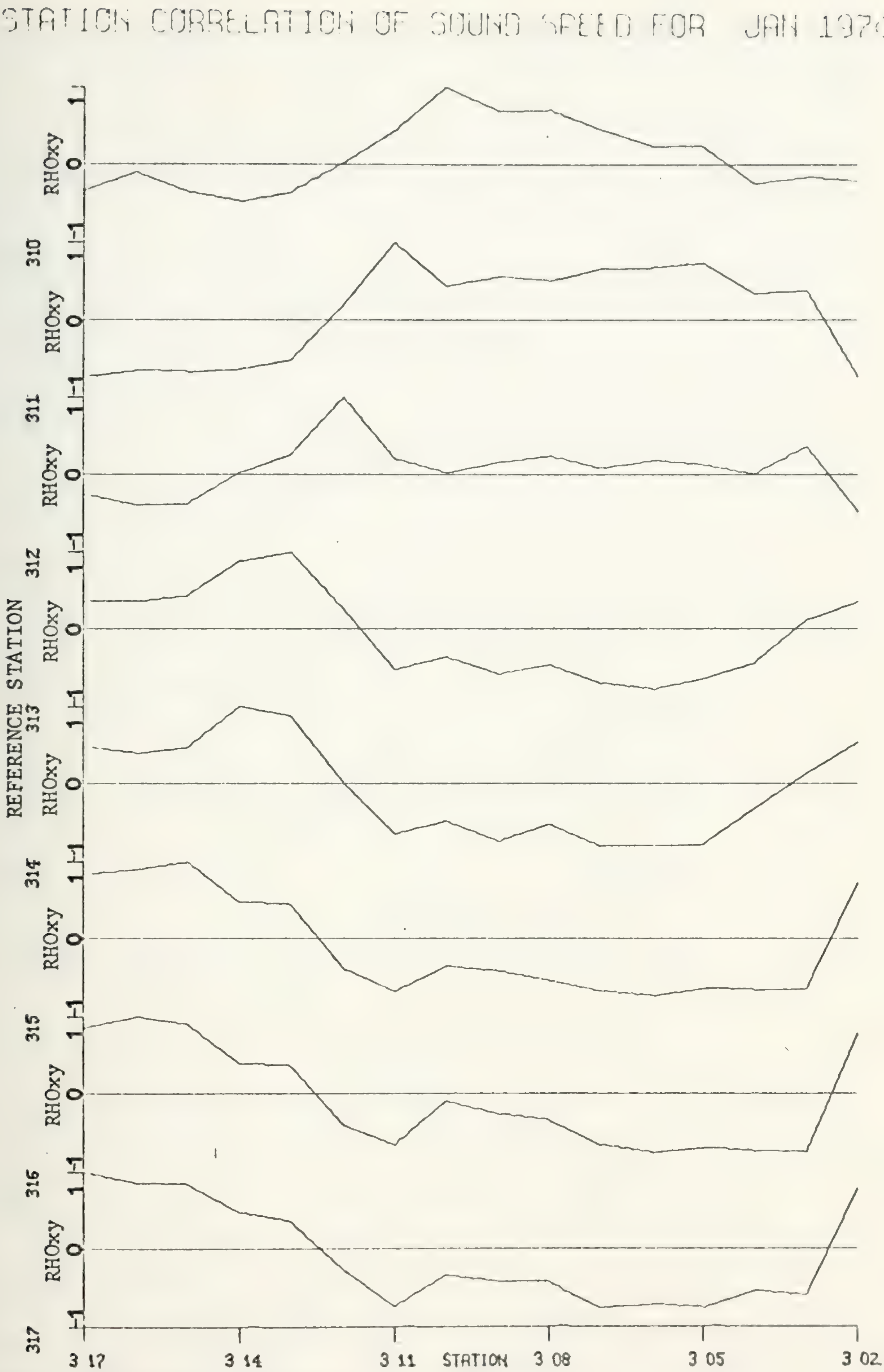

Figure 25. RHOxy by station.

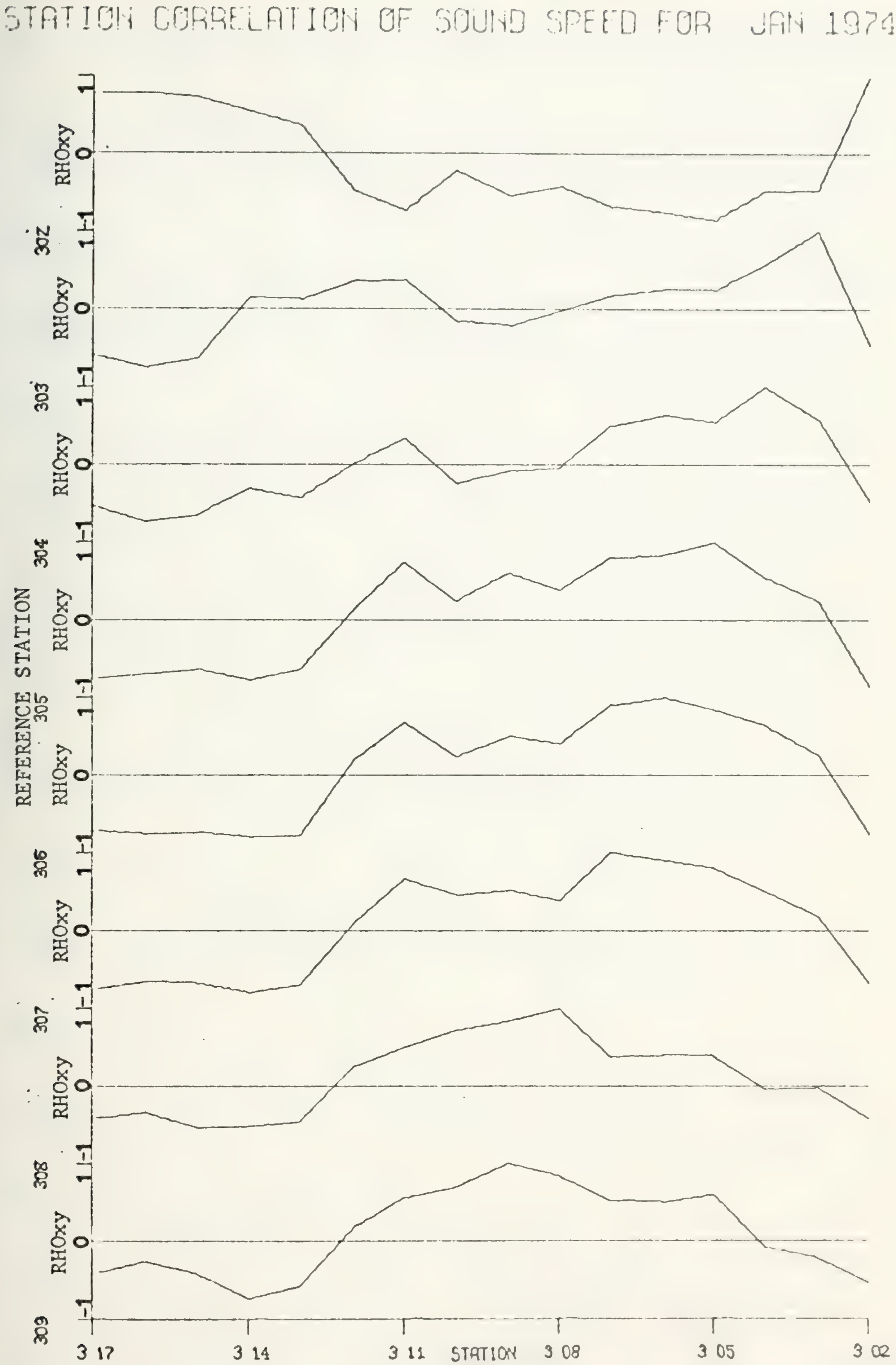

Figure 26. RHOxy by station.

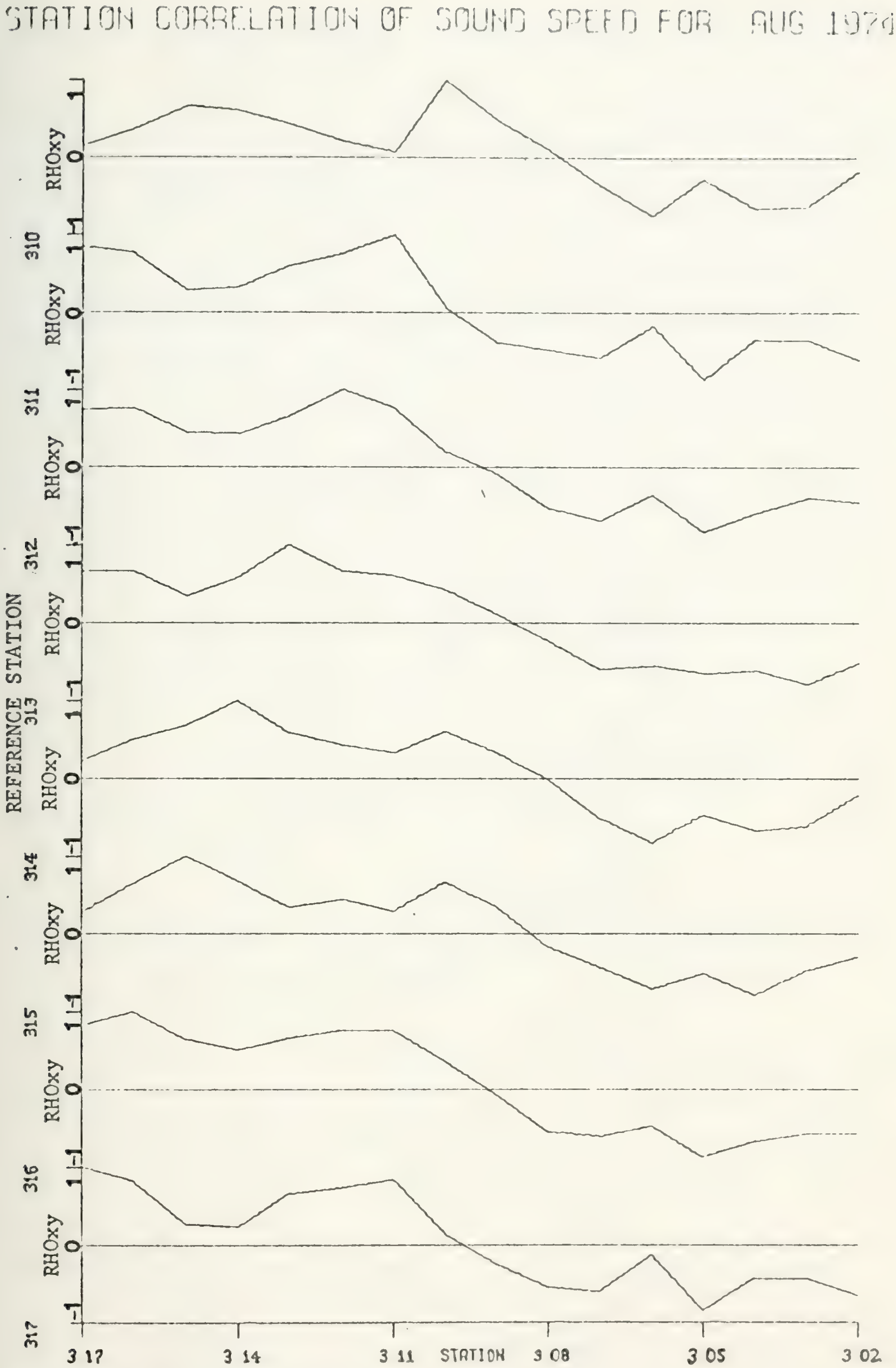

Figure 27. RHOxy by station.

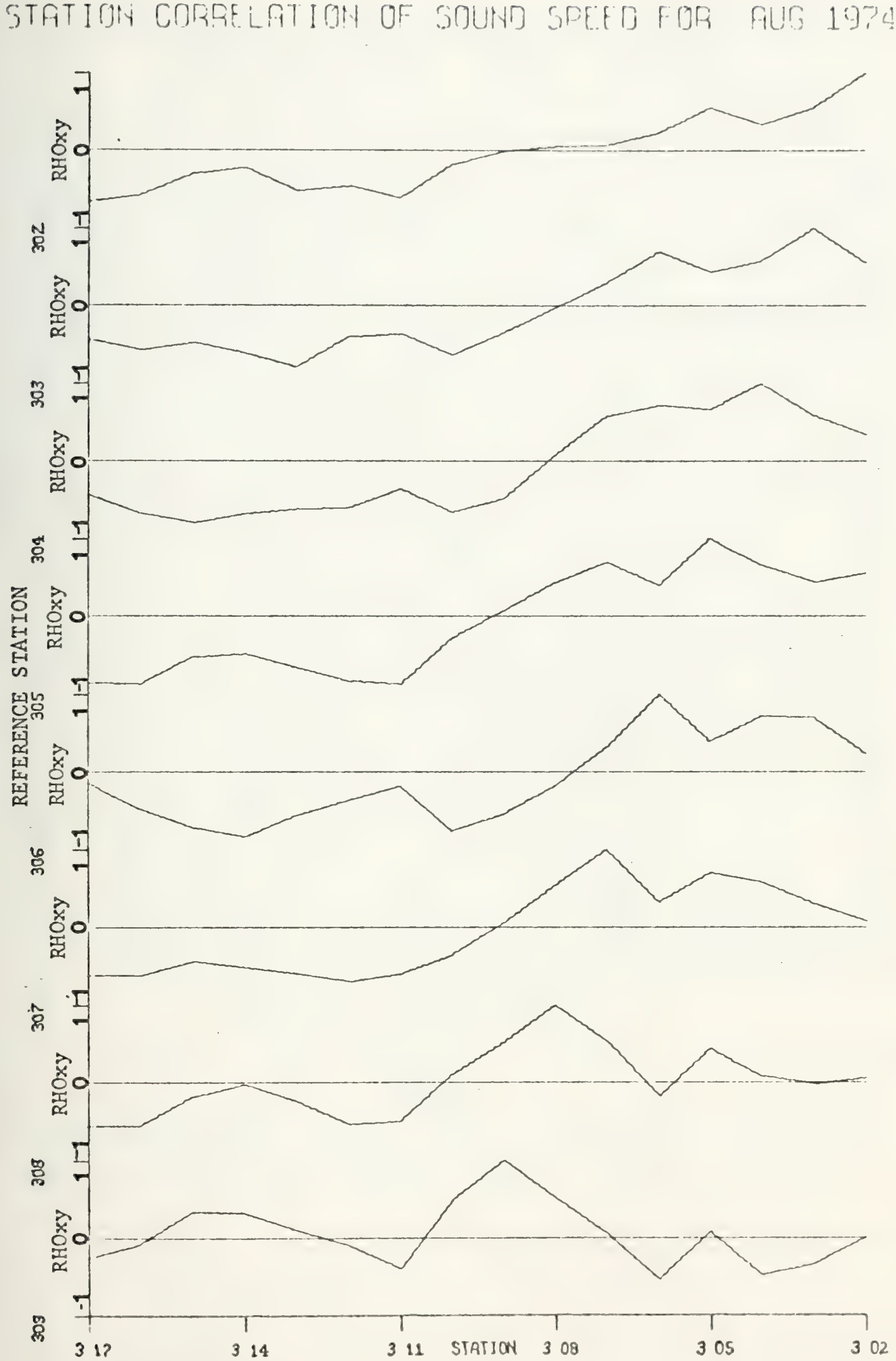

Figure 23. RHOxy by station.

STATION CORRELATION OF SOUND
SPEED FOR OCT 1973

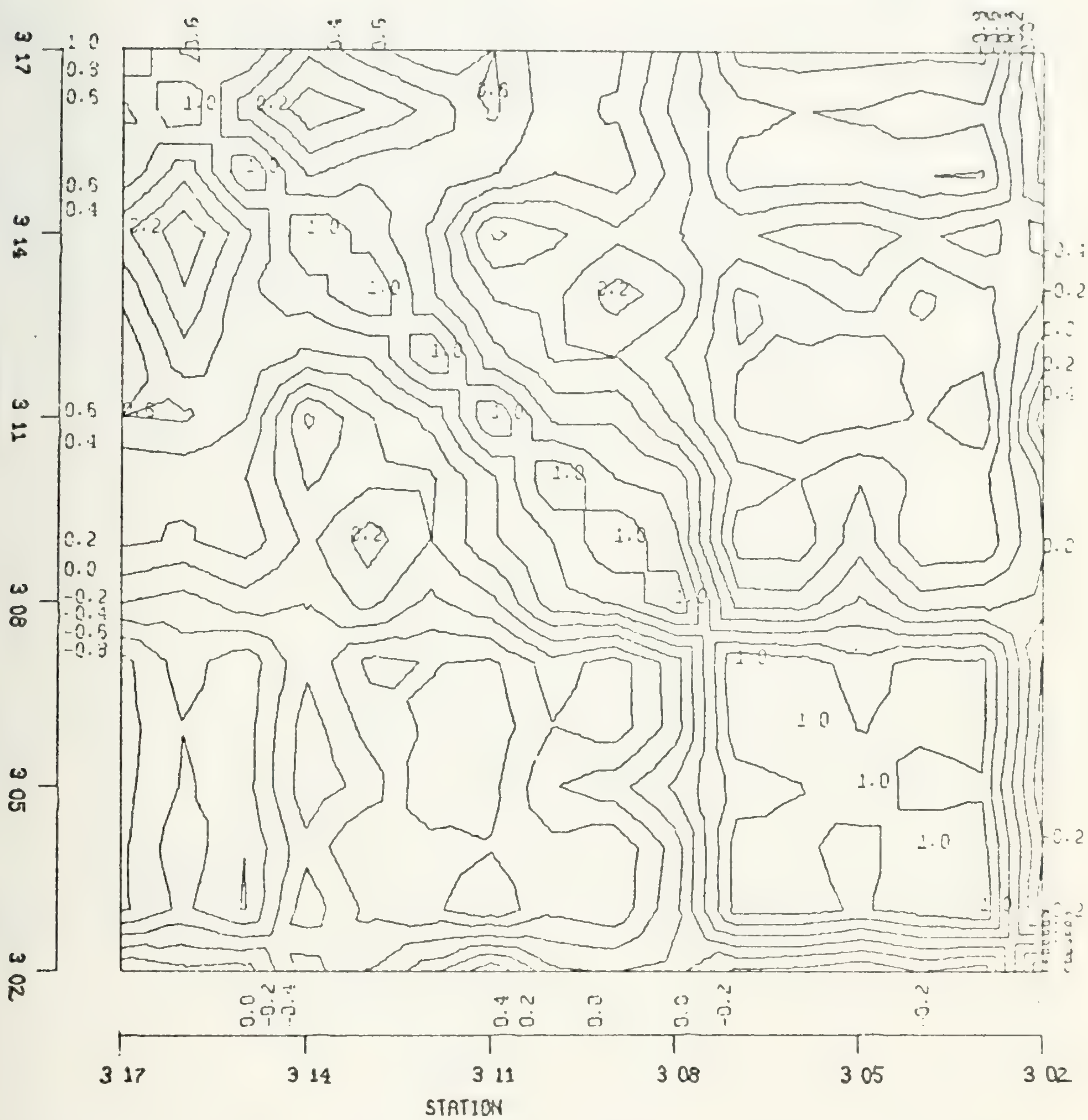

Figure 29. Contours of equal cross-correlation coefficient (RHOxy). Note the area of high correlation between station 307 and 303.

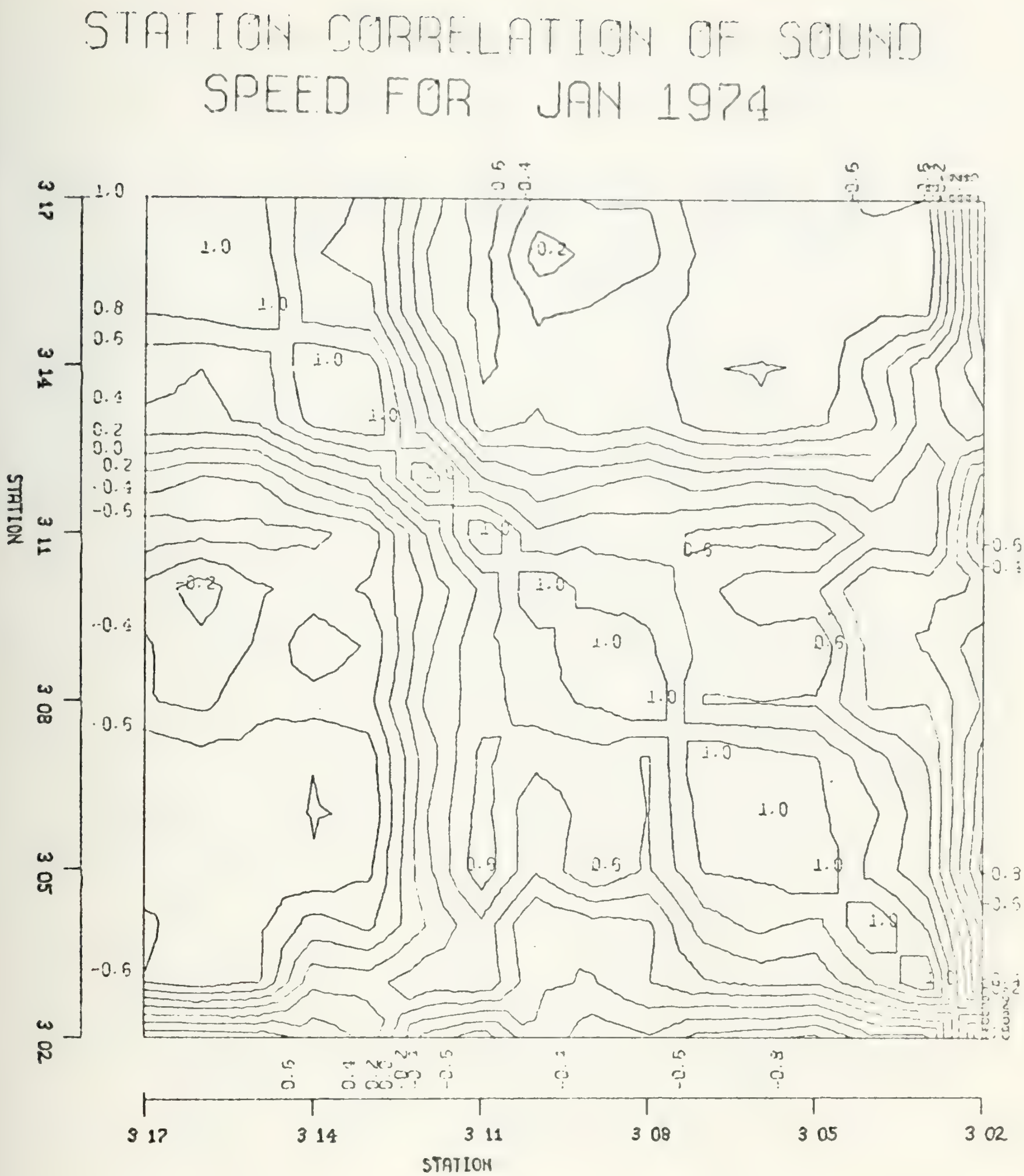

Figure 30. Contours of equal cross-correlation coefficient (RHOxy).

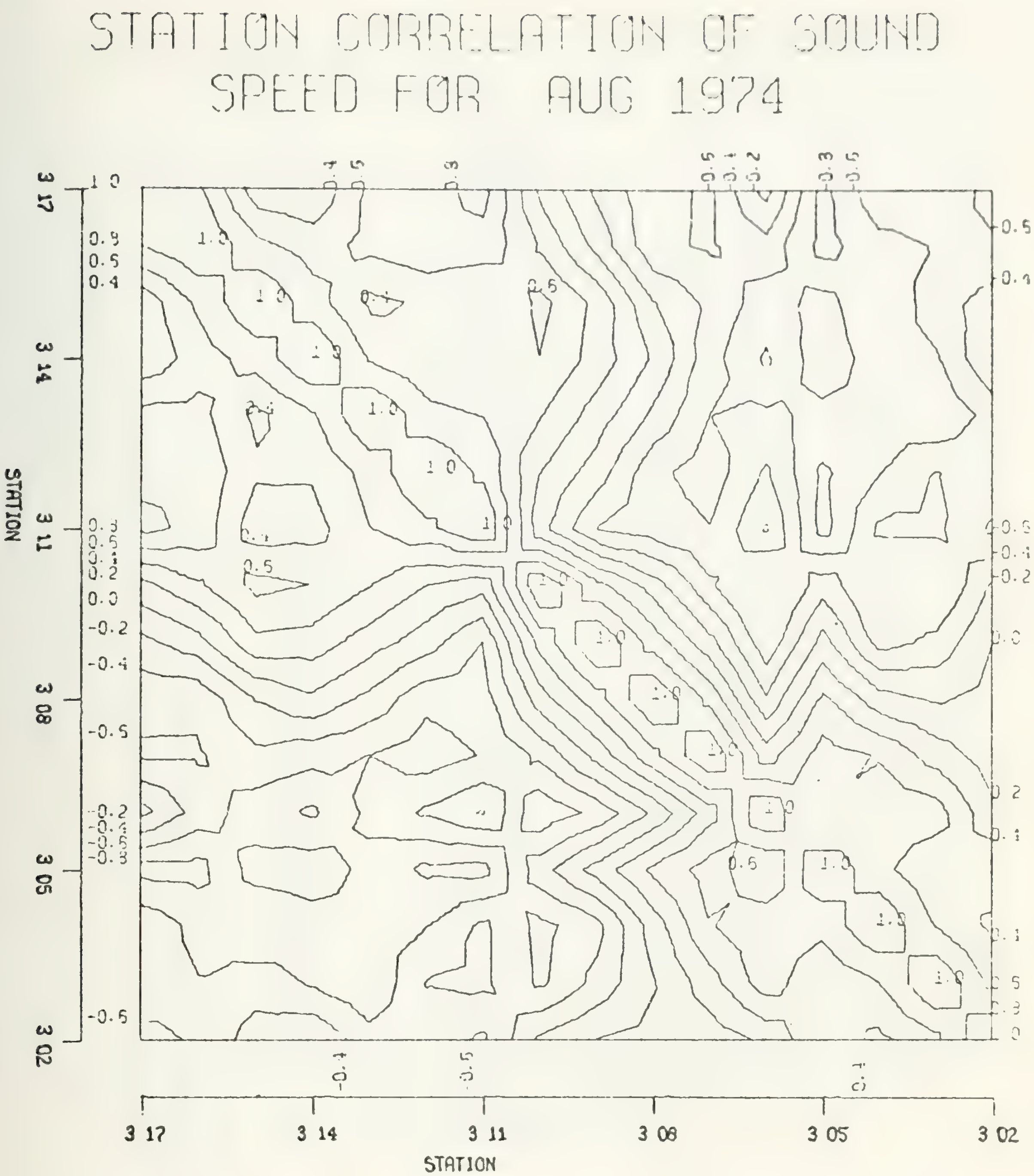

Figure 31. Contours of equal cross-correlation coefficient (RHOxy).

APPENDIX B

```
//HUGHES   JOB (2005,0824,0S42),' J G HUGHES SMC 2010',TIME=4,
//     MSGCLASS=0
// EXEC FORTCLG,REGION.FORT=150K,REGION.GO=250K,DEST=0
//FORT.SYSIN DD *
C TITLE           DIGISTD
C
C
C PROGRAMMERS     R.E.GREER,R.E.BLUMBERG,AND J.G.HUGHES EXTENSIVELY MODIFIED AN
C                 ORIGINAL PROGRAM,MIZ2, BY R.G.PAQUETTE.
C
C DOCUMENTATION   R.E.GREER
C
C DATE            26 JUNE 1975
C
C PURPOSE         PROGRAM READS,CONVERTS,AND PROCESSES DIGITIZED SALINITY,
C                 TEMPERATURE,AND DEPTH DATA FROM A CALMA DIGITIZER 7-TRACK
C                 TAPE.  DATA ARE COMPUTED AND STORED EVERY 0.01 INCHES OF DEPTH
C                 FOR OUTPUT TO PRINTER,PUNCHED CARD,OR 9-TRACK TAPE.  PROGRAM
C                 CONVERTS DEPTH,TEMPERATURE,SALINITY AND COMPUTES SOUND VELOCITY
C                 AND SIGMA-T FOR EACH INDIVIDUAL OCEANOGRAPHIC STATION AND
C                 PRINTS THE DATA IN A STATION DATA SUMMARY.
C
C SEQUENCE        THE PROGRAM PERFORMS ALL FUNCTIONS IN THE FOLLOWING SEQUENCE
C                 OF OPERATIONS:
C                     (A) INITIALIZES ALL ARRAYS AND VARIABLES.
C                     (B) COMPUTES TABLE OF SALINTIY AND TEMPERATURE SCALE
C                     COMVERSION FACTORS.
C                     (C) SKIPS XXX NUMBER OF RECORDS IF NSKP VARIABLE SET OTHER
C                     THAN ZERO ON CONTROL DATA CARD.
C                     (D) READS PAIR OF DATA CARDS (LABEL AND DAT) FOR RECORD
C                     BEING PROCESSED.
C                     (E) TERMINATES PROGRAM IF ISTOP=1 OR AT THE END OF
C                     PROCESSING THE NN-TH RECORD.
C                     (F) SKIPS UNREADABLE OR BAD RECORDS IF NRCSKP VARIABLE SET
C                     TO INDIVIDUAL RECORD NUMBER.
C                     (G) READS USEABLE DATA RECORD INTO A-ARRAY.
C                     (H) MOVES BYTES OF A-ARRAY INTO 4-BYTE WORDS OF B-ARRAY TO
C                     ALLOW PROCESSING BY STANDARD FORTRAN.
C                     (I) PROCESSES RAW B-ARRAY.
C                         (1) IF HEADER RECORD, PROGRAM DECODES HEADER LABEL AND
C                         COMPARES TO LABEL SUPPLIED BY DATA CARD.
```

```
C                        (2) IF TRACER RECORD, PROGRAM ADDS AND STORES CUMULATIVE
C                        SUMS OF X AND Y DISTANCE TRAVEL.
C                     (J) INDEXES THE VALUES OF CUMULATIVE DISTANCE BY INCREASING
C                     DEPTH UNITS; INTERPOLATES TO FILL GAPS IN THE FINAL ARRAY
C                     WHICH MAY OCCUR AT THE POINTS OF SCALE CHANGES IN THE
C                     SEGMENTED RECORD.
C                     (K) INSERTS MANUALLY ENTERED SURFACE AND NEAR SURFACE DATA
C                     VALUES VIA DATA CARD.
C                     (L) INCREMENTS RECORD COUNT AND REPEATS STEPS (D) THRU (K)
C                     UNTIL ALL RECORDS PROCESSED FOR PARTICULAR STATION.
C                     (M) ADJUSTS ALL FINAL DATA ARRAYS TO THE LENGTH OF THE
C                     SHORTEST.
C                     (O) COMPUTES SOUND VELOCITY.
C                     (P) COMPUTES SIGMA-T.
C                     (Q) COMPUTES CONSECUTIVE RECORD SERIALIZATION FOR TAPE
C                     OUTPUT NUMBERING SCHEME.
C                     (R) CONVERTS LETTER DESIGNATOR MONTH/YEAR CODE,AMONC, TO
C                     REAL *8 MONTH/YEAR.
C                     (S) PRINTS OCEANOGRAPHIC DATA STATION SUMMARY.
C                     (T) WRITES ALL STATION DATA ON TAPE IF TAPE=.TRUE..
C                     (U) PUNCHES ALL STATION DATA ON CARDS SUITABLE FOR THESISII
C                     INPUT IF CARDS=.TRUE..
C                     (V) PUNCHES DEPTH,TEMPERATURE,AND SALINITY ON CARDS
C                     SUITABLE FOR INPUT TO HYDROGRAPHIC PROGRAM IF GCARDS=.TRUE..
C                     (W) INITIALIZES ALL ARRAYS AND VARIABLES FOR PROCESSING
C                     NEXT STATION DATA.
C                     (X) REPEATS STEPS (D) THRU (W) UNTIL ALL RECORDS PROCESSED,
C                     ISTOP=1, OR DESIRED RECORD READ.
C
C FEATURES         PROGRAM CONSISTS OF MANY MARKED PROPERTIES WHICH MAKE IT A
C                  HIGHLY VERSATILE PROGRAM FOR PROCESSING OCEANOGRAPHIC DATA
C                  FROM TAPE. SOME OF THESE PROPERTIES ARE LISTED UNDER THE
C                  FOLLOWING SIX GENERAL CATEGORIES:
C                     (A) INPUT
C                        (1) 7-TRACK CALMA DIGITIZER TAPE IN BCD.
C                        (2) TWO DATA CARDS REQUIRED PER TRACE SEGMENT OR HEADER
C                        LABEL RECORD. EXAMPLE:  AN STD TEMPERATURE TRACE
C                        CONSISTING OF FOUR SEGMENTS OR RECORDS WILL REQUIRE FOUR
C                        PAIRS OF DATA CARDS.
C                     (B) SUBROUTINES
C                        (1) TPRD-  AN ASSEMBLER LANGUAGE SUBROUTINE FOR READING
C                        MAGNETIC TAPE WHICH CANNOT BE READ BY STANDARD METHODS.
C                        NOTE: TPRD ALLOWS USER TO SKIP BAD RECORDS WHILE TAPRD
C                        (W.R.CHURCH COMPUTER CENTER SUBROUTINE) DOES NOT.
C                        (2) CHMOVE-  MOVES BYTES OF A-ARRAY INTO FOUR BYTE WORDS
C                        OF B-ARRAY TO ALLOW PROCESSING BY STANDARD FORTRAN.
C                        (3) CONDNS-  CONDENSES,INDEXES,AND CONVERTS THE
C                        CUMULATIVE DISTANCE X AND Y ARRAYS,BY INCREASING DEPTH
```

```
C                     UNITS,TO TEMPERATURE AND DEPTH OR SALINITY AND DEPTH.
C                     (4) OUT1-  PRINTS OCEANOGRAPHIC STATION DATA SUMMARY.
C                     (5) SVEL-  COMPUTES SOUND VELOCITY FROM DEPTH,TEMPERATURE
C                     AND SALINITY ACCORDING TO WILSON'S EQUATION.
C                     (6) SIGMT-  COMPUTES SIGMA-T FROM TEMPERATURE AND
C                     SALINITY ACCORDING TO H.O.614 P.91.
C                  (C) AUTOMATIC DATA PROCESSING/HANDLING
C                     (1) APPLICABLE TO MULTIPLE DEPTH,TEMPERATURE AND SALINITY
C                     SCALES.
C                     (2) HANDLES OPERATOR MISTAKES MADE IN TRACING STD CURVES
C                     ON CALMA DIGITIZER.
C                     (3) SKIPS AN INITIAL NUMBER OF RECORDS SPECIFIED BY NSKP
C                     AND INDIVIDUAL RECORDS(EVEN IF UNREADABLE) SPECIFIED BY
C                     THE ARRAY NRCSKP.
C                     (4) DECODES 7-TRACK TAPE HEADER LABELS AND TRACE RECORDS.
C                     (5) COMPUTES DATA FOR EVERY 0.01 INCHES DEPTH BUT
C                     SELECTABLE FOR GREATER DEPTH INTERVAL.
C                     (6) ENTERS HAND-ENTERED DATA FOR SURFACE AND NEAR-SURFACE
C                     VALUES.
C                     (7) EDITS OUT ANY UNFILLED ARRAY POSITIONS.
C                     (8) COMPUTES CONSECUTIVE RECORD SERIALIZATION FOR TAPE
C                     OUTPUT NUMBERING SCHEME.
C                     (9) COMPUTES SOUND VELOCITY AND SIGMA-T.
C                  (D) DIAGNOSTICS
C                     (1) WRITES FIRST TWENTY-FIVE VALUES OF B-ARRAY FOR
C                     INSPECTION PURPOSES.
C                     (2) WRITES EVERY TWENTIETH VALUE OF STD ARRAYS FOR
C                     DATA INSPECTION PURPOSES.
C                     (3) WRITES PROGRAM STATEMENT NUMBER IN ADDITION TO
C                     MESSAGE WHEN SIGNIFICANT OPERATIONS OCCUR.
C                  (E) TROUBLE-SHOOTING
C                     (1) HANDLES MULTIPLE KEYBOARD AND TRACER SYMBOL ENTRIES.
C                     (2) PROVIDES FOR A MISSED HEADER LABEL OR INCOMPLETE
C                     HEADER LABEL.
C                     (3) HANDLES MISSING INTER-RECORD GAPS.
C                     (4) HANDLES DELETE RECORD BY INCREMENTING RECORD COUNT
C                     AND READING SAME PAIR OF DATA CARDS AGAIN.
C                     (5) COMPARES CARD HEADER LABEL AGAINST TAPE HEADER LABEL
C                     AND ACCEPTS CARD VALUES IF CARD AND TAPE DISAGREE.
C                  (F) OUTPUT
C                     (1) PRINTER-  TWO PRINTING VARIABLES,PRT1 AND PRT2.
C                        (A) OCEANOGRAPHIC DATA STATION SUMMARIES.
C                        (B) PRT2, PROVISION ONLY.
C                     (2) CARD-  TWO CARD PUNCHING ROUTINES,CARDS AND GCARDS.
C                        (A) PUNCHED DATA CARDS SUITABLE FOR USE WITH THESISII.
C                        (B) PUNCHED DATA CARDS FOR INPUT TO HYDROGRAPHIC
C                        PROGRAM.
C                     (3) TAPE-  9-TRACK TAPE
```

```
C                   (4) PLOTTING-  PROVISIONS FOR PLOTTING ROUTINES ACTUATED
C                   BY PLT1 AND PLT2 ARE NOT PRESENTLY PROGRAMMED.
C
C ARGUMENTS      PROGRAM CONSISTS OF MANY TERMS,ARRAYS AND VARIABLES.  THE
C                FOLLOWING IS A BRIEF DESCRIPTION OF THE IMPORTANT ARGUMENTS
C                LISTED ALPHABETICALLY UNDER TWO GENERAL CATEGORIES.
C                   (A) ARRAYS
C                   (1) D,T,S,D2,T2,S2   = DEPH,TEMPERATURE AND SALINITY
C                   (2) DH,TH,SH         = HAND-ENTERED SURFACE AND NEAR
C                                        SURFACE DATA VALUES.
C                   (3) X,Y              = CUMULATIVE SUMS OF DISTANCE AND
C                                        DEPTH TRAVEL.
C                   (4) NRCSKP           = NUMBER OF INDIVIDUAL RECORD SKIPPED
C                   (5) DCON             = DEPTH CONVERSION FACTOR.
C                   (6) CORRS,CORRT      = ADDITIVE CORRECTIONS TO SALINITY
C                                        AND TEMPERATURE ASSOCIATED WITH STD
C                                        SCALE CHANGES.
C                   (7) IREC             = CONSECUTIVE SERIAL RECORD NUMBER.
C                   (8) AMONCA           = MONTH/YEAR CODE LETTER.
C                   (9) EVENT            = MONTH AND YEAR.
C                 (B) TERMS
C                   (1) CARDS            = VARIABLE PERMITS PUNCHING CARDS.
C                   (2) CONTRL           = NAMELIST VARIABLE USED FOR
C                                        INFREQUENTLY CHANGED VARIABLES.
C                   (3) CORD             = DEPTH CORRECTION TERM.
C                   (4) DAT              = NAMELIST VARIABLE USED FOR
C                                        FREQUENTLY CHANGED VARIABLES.
C                   (5) DLTREC           = DELETE RECORD
C                   (6) FLAG             = INDICATES START OF DATA TRACE.
C                   (7) GCARDS           = VARIABLE PERMITS PUNCHING CARDS FOR
C                                        HYDROGRAPHIC PROGRAM INPUT.
C                   (8) GCRD             = NUMBER OF HYDROGRAPHIC CARDS TO BE
C                                        PUNCHED.
C                   (9) ICODE      .     = VARIABLE USED TO IDENTIFY EITHER
C                                        TEMPERATURE OR SALINITY TRACE RECORD.
C                   (10) ICSQZ           = VARIABLE USED TO COMPRESS NUMBER
C                                        OF DATA VALUES OUTPUT TO CARDS
C                                        PUNCHING ROUTINE.
C                   (11) IGSQZ           = VARIABLE USED TO COMPRESS NUMBER
C                                        OF DATA VALUES OUTPUT TO GCARDS
C                                        PUNCHING ROUTINE.
C                   (12) ISQZ            = VARIABLE USED TO COMPRESS NUMBER
C                                        OF DATA VALUES OUTPUT TO PRINTER.
C                   (13) IDEPTH          = VARIABLE USED TO IDENTIFY HEADER
C                                        LABEL OR TRACE RECORD.
C                   (14) ISCL            = THE SCALE NUMBER ON THE STD
C                                        SALINITY SCALE DIAL.
C                   (15) ITSCL           = THE SCALE NUMBER ON THE STD
```

```
C                           TEMPERATURE SCALE DIAL.
C      (16) IDSCL           = THE SCALE NUMBER ON THE STD DEPTH
C                           SCALE DIAL.
C      (17) ISTA            = VARIABLE IDENTIFIES STATION NUMBER.
C      (18) IP              = WHEN SET EQUAL TO 1 ON &DAT, IP IS
C                           A PRINT COMMAND TO CAUSE DATA TO BE
C                           OJTPUT AND VARIABLES INITIALIZED FOR
C                           THE NEXT STATION.
C      (19) IH              = NUMBER OF HAND-ENTERED SURFACE OR
C                           NEAR-SURFACE DATA VALUES.
C      (20) IHDR            = WHEN SET EQUAL TO 1 PERMITS
C                           ENTERING MISSING OR FAULTY DIGITIZER
C                           TAPE HEADER INFO VIA DATA CARD.
C      (21) ISTOP           = TERMINATES PROGRAM IF SET EQUAL TO
C                           1 ON A FINAL &DAT CARD PRECEDED BY
C                           A LABEL CARD.
C      (22) JREC            = VARIABLE USED TO COUNT RECORDS FOR
C                           RECORD SERIALIZATION PURPOSES.
C      (23) JSKIP           = WHEN SET EQUAL TO 1 ON THE LABEL
C                           CARD, CAUSES THE PROGRAM TO ACCEPT
C                           DATA ON AN &CONTRL CARD.
C      (24) KEY             = THE KEYBOARD SYMBOL ON THE
C                           DIGITIZER TAPE.
C      (25) KCRD            = NUMBER OF DATA POINTS TO BE PUNCHED
C                           BY CARDS PUNCHING ROUTINE.
C      (26) KDTA            = NUMBER OF RECORDS PROCESSED FOR
C                           PARTICULAR STATION.
C      (27) LABEL           = HEADER TYPE DATA CARD WHICH
C                           IDENTIFIES STATION NUMBER AND TYPE
C                           TRACE, TEMPERATURE OR SALINITY.
C      (28) NCRDS           = NUMBER OF CARDS PUNCHED BY CARDS
C                           PUNCHING ROUTINE.
C      (29) NE              = THE INDEX AT THE LAST USEFUL ARRAY
C                           POSITION OF THE X(DEPTH) ARRAY.
C      (30) NOIRG           = VARIABLE USED TO INDICATE MISSING
C                           END OF RECORD GAP ON TAPE.
C      (31) NSKP            = NUMBER OF INITIAL RECORDS ON TAPE
C                           SKIPPED.
C      (32) SCON            = SALINITY SCALE CONSTANT.
C      (33) SCOR            = CORRECTION FACTOR ADDED TO SALINITY
C                           DATA VALUES.
C      (34) TCON            = TEMPERATURE SCALE CONSTANT.
C      (35) TCOR            = CORRECTION FACTOR ADDED TO
C                           TEMPERATURE DATA VALUES.
C      (36) WMONTH          = MONTH AND YEAR
C
C
C DATA DECK      THE FOLLOWING IS A SAMPLE DATA DECK REQUIRED BY THIS
```

```
C                   PROGRAM. SAMPLE BELOW SHOWS DATA CARDS REQUIRED FOR TWO
C                   STATIONS, 3070 AND 3080. ALSO SHOWN IS 'STATION END' CARD
C                   WTIH ISTOP SET EQUAL TO ONE.
C
 &CONTRL NN=400,TAPE=F,CARDS=F,GCARDS=F,ISQZ=01,NSKP=90,NRCSKP=103,104,105,
 106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,122,123,
 124,125,126,175,176,177,178,179,180,181,182,183,184,185,186,ICSQZ=8,
 IGSQZ=8,TCOR=-0.08,SCOR=0.04,&END
     UCM004     INCLUDES STATIONS  3070 THRU 302R MINUS 3080,3090 AND 3140.
 STATION 3070 TEMPERATURE HEADER                                            0
 &DAT ISTA=307,AMONC='0',IDEPTH=99,IDSCL=1,ICODE=0,ITSCL=4,ISCL=3,IP=0,
 DH=0.0,TH=11.24,SH=33.40,IH=1,&END
 STATION 3070 TEMPERATURE TRACE
 &DAT  IDEPTH=00&END
 STATION 3070 TEMPERATURE HEADER                                            0
 &DAT IDEPTH=99,ITSCL=3&END
 STATION 3070 TEMPERATURE TRACE
 &DAT  IDEPTH=00&END
 STATION 3070 TEMPERATURE HEADER                                            0
 &DAT IDEPTH=99,IDSCL=2&END
 STATION 3070 TEMPERATURE TRACE
 &DAT  IDEPTH=00&END
 STATION 3070 TEMPERATURE HEADER                                            0
 &DAT IDEPTH=99,ITSCL=2&END
 STATION 3070 TEMPERATURE TRACE
 &DAT  IDEPTH=00&END
 STATION 3070 SALINITY HEADER                                               0
 &DAT IDSCL=1,IDEPTH=99,ICODE=1,ITSCL=4,&END
 STATION 3070 SALINITY TRACE                                                0
 &DAT  IDEPTH=00&END
 STATION 3070 SALINITY HEADER                                               0
 &DAT IDSCL=2,IDEPTH=99,IP=1,&END
 STATION 3070 SALINITY TRACE                                                0
 &DAT  IDEPTH=00&END
 STATION 3080 TEMPERATURE HEADER                                            0
 &DAT ISTA=308,AMONC='0',IDEPTH=99,IDSCL=1,ICODE=0,ITSCL=4,ISCL=3,IP=0,&END
 STATION 3080 TEMPERATURE TRACE
 &DAT  IDEPTH=00&END
 STATION 3080 TEMPERATURE HEADER                                            0
 &DAT IDEPTH=99,ITSCL=3,&END
 STATION 3080 TEMPERATURE TRACE
 &DAT  IDEPTH=00&END
 STATION 3080 TEMPERATURE HEADER                                            0
 &DAT IDEPTH=99,IDSCL=2&END
 STATION 3080 TEMPERATURE TRACE
 &DAT  IDEPTH=00&END
 STATION 3080 TEMPERATURE HEADER                                            0
 &DAT IDEPTH=99,ITSCL=2&END
```

```
 STATION 3080 TEMPERATURE TRACE
 &DAT   IDEPTH=00&END)
 STATION 3080 SALINITY HEADER                                                   0
 &DAT IDSCL=1,IDEPTH=99,ICODE=1,ITSCL=4,&END
 STATION 3080 SALINITY TRACE                                                    0
 &DAT   IDEPTH=00&END
 STATION 3080 SALINITY HEADER                                                   0
 &DAT IDSCL=2,IDEPTH=99,IP=1,&END
 STATION 3080 SALINITY TRACE                                                    0
 &DAT   IDEPTH=00&END
 STATION END                                                                   1
C (END OF FILE)
C
C
C DECK SET-UP    THE FOLLOWING IS AN EXAMPLE OF JOB CONTROL LANGUAGE
C                AND DECK SET-UP REQUIRED TO USE DIGISTD. THIS
C                PARTICULAR DECK SET-UP WAS USED TO WRITE FILE 6 ON
C                9-TRACK TAPE, NPS-527. THE 9-TRACK TAPE WAS WRITTEN AT
C                800 BPI WITH A LRECL OF 40 AND BLKSIZE OF 32,520.
C                HINDSIGHT INDICATES THAT IT IS DESIRABLE TO WRITE
C                THE TAPE AT A BLKSIZE OF 8000 VICE 32,520 SINCE IT IS
C                EXTREMELY ADVANTAGEOUS TO KEEP FOLLOW ON TAPE
C                PROCESSING PROGRAMS SMALL (IE LESS THAN 100K).
C
C
//GUCMSTD6 JOB (2006,0823,0S42),' RE GREER SMC 1413',TIME=10,
//     TYPRUN=HOLD,
//     MSGCLASS=0
// EXEC FORTCLG,REGION.FORT=150K,REGION.GO=350K,DEST=0
//FORT.SYSIN DD *
C       ( MAIN SOURCE DECK AND SUBROUTINES)
//GO.FT06F001 DD SPACE=(CYL,(40,03)),SYSOUT=0
//GO.FT07F001 DD DUMMY
//GO.FT08F001 DD UNIT=3400-4,VOL=SER=NPS527,LABEL=(06,SL,,OUT),
//   DISP=(NEW,KEEP),DCB=(DEN=2,RECFM=FB,LRECL=40,BLKSIZE=32520),
//   DSN=S2006.UCM7374
//GO.METTAP DD UNIT=2400-1,VOL=SER=UCM004,DISP=OLD,LABEL=(,NL),
//       DCB=(DEN=1,TRTCH=ET)
//GO.SYSIN DD *
C       (DATA DECK)
C (END OF FILE)
C
C MAIN PROGRAM
C
C
C       *********************  D I G I S T D  *************************
C
C
```

```
      DIMENSION X(4001), Y(4001), LABEL(19), SH(50), TH(50), DH(50),
     1INTA(10), INSA(10), NRCSKP(99), DCON(3), CORRS(7), CORRT(7),
     2IREC(1801), AMONCA(13), EVENT(13)
      INTEGER B(8001),ZER,DOL,STAR,ONE,FLAG,DLTREC,ZERO,DLR,BLANK,GCRD,
     1A(2001),TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,TEN,ELEVEN,AMONT,FG
      LOGICAL PRT1,PRT2,PLT1,PLT2,TAPE,ENDFL,CARDS,SKIP,GCARDS
      COMMON /C1/ T(1801),S(1801),D(1801),SV(1801),SIG(1801),
     1S1(1801),T1(1801),D2(1801),S2(1801),T2(1801)
      REAL *8EVENT,WMONTH
      DATA AMONCA/'H','I','C','K','L','O','P','Q','R','U','V','W','Z'/
      DATA EVENT/'AUG 1973','SEP 1973','OCT 1973','NOV 1973','DEC 1973',
     1'JAN 1974','FEB 1974','MAR 1974','APR 1974','MAY 1974','JUN 1974',
     2'JUL 1974','AUG 1974'/
C     ******************************************************************
C
      NAMELIST /CONTRL/ NN,PRT1,PRT2,PLT1,PLT2,TAPE,ENDFL,CARDS,ISTOP,IP
     1,IH,NRCSKP,NSKP,JSKIP,JREC,ISQZ,ICSQZ,IGSQZ,GCARDS,TCOR,SCOR
     2/DAT/SH,TH,DH,IH,ICODE,ISCL,ITSCL,IDSCL,IP,IDEPTH,ISQZ,IGSQZ,ICSQZ
     3,SCOR,TCOR,IHDR,NOIRG,ISTA,TCON,SCON,DCON,CORD,SKIP,CORRS,CORRT,
     4AMONC,TAPE,CARDS,GCARDS
C
C       ****************************************************************
C       ********************** DEFINE SYMBOLS **************************
C
C       DEFINE SYMBOLS,NOTING THAT THE LEFT THREE HEX BYTES IN EACH
C       ELEMENT OF B END UP FILLED WITH BLANKS
      DATA DOL/'$$$$'/,STAR/Z4040405C/,KEY/Z4040405F/,ONE/Z404040F1/,
     1FLAG/Z40404050/,DLTREC/Z40404060/,MINUS/Z40404061/,
     2 DLR/Z4040405B/,BLANK/'    '/,ZER/Z404040F0/,TWO/Z404040F2/,
     3THREE/Z404040F3/,FOUR/Z404040F4/,FIVE/Z404040F5/,
     4MTWO/Z404040E2/,MTHREE/Z404040E3/,MFOUR/Z404040E4/,MFIVE/Z404040E5
     5/,SIX/Z404040F6/,SEVEN/Z404040F7/,EIGHT/Z404040F8/,NINE/Z404040F9
     6/,TEN/Z404040F0/,ELEVEN/Z4040407B/
C
C       ****************************************************************
C       ********************** DEFINE CONSTANTS ************************
C
C       THE FOLLOWING CONVERSION FACTORS ARE IN HUNDREDTHS OF INCHES PER
C       UNIT OF S OR T.  THEY MAY BE OVERRIDDEN BY THE DATA CARDS.
      DCON(1) = 3.153
      DCON(2) = 1.261
      DCON(3) = 0.631
      TCON = 189.680
      SCON = 474.200
C
C       ****************************************************************
C       ************** INITIALIZE ALL TERMS AND VARIABLES **************
C
```

```
      DATA CARDS/.FALSE./,CORD/0.0/,ENDFL/.FALSE./,FG/0/,GCARDS/.FALSE./
     1,ICODE/0/,ICSQZ/1/,IGSQZ/1/,IH/0/,IHDR/0/,IP/0/,IPS/8000/,ISCL/0/,
     2IDEPTH/1/,IDSCL/0/,ISTA/999/,ITSCL/0/,
     3ISQZ/1/,ISTOP/0/,JJJ/0/,JJJJ/0/,JREC/0/,JSAV/0/,KBARF/0/,KSCARF/0/
     4,KDTAF/1/,KDTA/1/,KDT1/1/,KDTH1/1/,KDTH2/1/,KS/1/,KS1/1/,
     5KS2/1/,KT/1/,KT1/1/,KT2/1/,NE/0/,NOIRG/0/,NSKP/0/,PLT1/.FALSE./,
     6PLT2/.FALSE./,PRT1/.TRUE./,PRT2/.FALSE./,SCOR/0.0/,SKIP/.FALSE./,
     7TAPE/.FALSE./,TCOR/0.0/
C
C      ****************************************************************
C      ******************** INITIALIZE ALL ARRAYS ********************
C
C      GIVE THE ARRAYS INITIAL VALUES
C
C
      DO 20 J=1,50
      SH(J) = 0.0
      TH(J) =-5.0
      DH(J) = 0.0
   20 CONTINUE
C
C
C
C
      DO 30 J=1,1801
      D(J) = 0.0
      T(J) =-5.0
      S(J) = 0.0
      D2(J) = 0.0
      T2(J) =-5.0
      S2(J) = 0.0
      T1(J) =-5.0
      S1(J) = 0.0
      IREC(J) = 0
   30 CONTINUE
C
C
C
C
      DO 40 J=1,99
      NRCSKP(J) = 0
   40 CONTINUE
C
C
C
C
      DO 50 J=1,7,1
      CORRS(J) = 0.0
```

```
      CORRT(J) = 0.0
   50 CONTINUE
C
C
C      PROVIDE INITIAL INDICES FOR 10 SALINITY SEGMENTS (INSA) AND 10
C      TEMPERATURE SEGMENTS (INTA).
      INSA(1) = 1
      INSA(2) = 1
      INTA(1) = 1
      INTA(2) = 1
C
      DO 60 J=3,10
      INSA(J) = 980
      INTA(J) = 980
   60 CONTINUE
C
C      COMPUTE A TABLE OF CONVERSION FACTORS FOR SALINITY AND
C      TEMPERATURE. CORRS AND CORRT REPRESENT THE S OR T VALUE AT THE
C      LEFT HAND SIDE OF THE STD TRACE. THE VALUE (J) TO BE USED WILL
C      COME FROM ISCL AND ITSCL. HYTECH STD MODEL 9006 STANDARD
C      TEMPERATURE AND SALINITY SCALES 1 THRJ 7 ARE PROVIDED FOR IN
C      THIS PROGRAM IN ADDITION TO DEPTH SCALES 1,2, AND 3. FOR
C      CONVENIENCE THE SCALES FOR TEMPERATURE, SALINITY, AND DEPTH ARE
C      DEFINED HERE.
C     TEMPERATURE SCALES:
C        ITSCL 1= -2 TO 3  (DEG CELSIUS)
C        ITSCL 2=  2 TO 7  (DEG CELSIUS)
C        ITSCL 3=  6 TO 11 (DEG CELSIUS)
C        ITSCL 4= 10 TO 15 (DEG CELSIUS)
C        ITSCL 5= 14 TO 19 (DEG CELSIUS)
C        ITSCL 6= 18 TO 23 (DEG CELSIUS)
C        ITSCL 7= 22 TO 27 (DEG CELSIUS)
C     SALINITY SCALES:
C        ISCL  1= 30.0 TO 32.0  (PPT)
C        ISCL  2= 31.5 TO 33.5  (PPT)
C        ISCL  3= 33.0 TO 35.0  (PPT)
C        ISCL  4= 34.5 TO 36.5  (PPT)
C        ISCL  5= 36.0 TO 38.0  (PPT)
C        ISCL  6= 37.5 TO 39.5  (PPT)
C        ISCL  7= 30.0 TO 40.0  (PPT)
C     DEPTH SCALES:
C        DCON(1)=  0.0 TO 300.0  (METERS)
C        DCON(2)=  0.0 TO 750.0  (METERS)
C        DCON(3)=  0.0 TO 1500.0 (METERS)
C
      CORRT(7) = 22.0
      CORRS(7) = 30.0
C
```

```
C
      DO 70 J=1,6,1
      FJ = J
      CORRT(J) = -2.0+(FJ-1.0)*4.0
      CORRS(J) = 30.0+(FJ-1.0)*1.5
   70 CONTINUE
C
C
C
C       ****************************************************************
C       ***** BEGIN PROCESSING; READ INITIAL DATA FROM TWO CARDS ********
C       PROGRAM PROVIDES FOR READING NSKP RECORDS WITHOUT PROCESSING.
C       NSKP, AS WELL THE 99 VALUES OF NRCSKP MUST BE ON THE FIRST
C       CONTRL CARD. A SINGLE CONTRL CARD IS READ HERE TO SET NSKP AND
C       NRCSKP. THERE ALSO MAY BE AN INFORMATIVE LABEL EXPLAINING HOW
C       MANY AND WHICH RECORDS SKIPPED.
      READ (5,CONTRL)
      READ (5,170) LABEL
      WRITE (6,180) LABEL
C
C       IF TAPE=.TRUE., TAPE MUST BE REWOUND AND APPROPRIATE JCL MUST
C       BE PROVIDED TO DEFINE IT. SEE JCL FOR EXAMPLE IN PRECEDING
C       PROGRAM DOCUMENTATION SECTION.
      IF (TAPE) REWIND 8
      IF (NSKP.EQ.0) GO TO 140
C
C       ****************************************************************
C       ************************* START SKIP LOOP **********************
C
C
      DO 80 IS=1,NSKP
      IIS = IS
C
C       THE VARIABLE,IPS, IS SET NEGATIVE DURING THE RECORD SKIP PROCESS.
C       THIS AVOIDS TPRD STOPPING ON UNREADABLE OR BAD RECORDS. NO DATA
C       CARDS ARE REQUIRED FOR INITIALLY SKIPPED RECORDS.
C       IMPORTANT NOTE:  INITIALLY SKIPPED RECORDS (NSKP) DIFFER FROM
C       INDIVIDUALLY SKIPPED RECORDS (NRCSKP) IN THAT NRCSKP REQUIRES
C       DATA CARDS AND PERMITS 99 INDIVIDUAL RECORDS TO BE SKIPPED WHILE
C       NSKP DOES NOT REQUIRE DATA CARDS AND PERMITS MULTIPLE RECORDS TO
C       BE SKIPPED. (IE. NSKP=40, THE FIRST 40 RECORDS ON THE TAPE BEING
C       READ WILL BE SKIPPED; WHEREAS NRCSKP=22,23,24,50 PERMITS RECORD
C       NUMBERS 22,23,24,50 TO BE SKIPPED INDIVIDUALLY.)
C
      IPS = -8000
   80 CALL TPRD (A,IPS,&100,&120)
C
C
```

```
C
C     ********************************************************************
C     **************** RESET IPS FOR NORMAL TAPE PROCESSING ***********
      IPS = 8000
      WRITE (6,90) IIS
   90 FORMAT (/5X,I5,' RECORDS SKIPPED'/)
      GO TO 140
C
C      IF END OR  ERROR MESSAGES OCCUR DURING SKIP ROUTINE, PROGRAM
C      STOPS.
  100 WRITE (6,110) IIS
  110 FORMAT (/5X,'FOUND END OF FILE ON RECORD',I4,'DURING SKIP PROCESS'
     1 /)
      GO TO 1580
  120 WRITE (6,130) IIS,A(1),A(2),A(3),A(4)
  130 FORMAT (/5X,'READ ERROR ON RECORD',I5,'ERROR STATISTICS ARE: ',4Z8
     1)
      GO TO 1580
C     ********************************************************************
C     ************************ END SKIP LOOP ************************
C
C      REDEFINE LOOP INDEX TO START AT ONE.
  140 NNN = NN-NSKP
C
C     ********************************************************************
C     ************** START MAIN LOOP FOR EACH RECORD ****************
      IT = 1
  150 IF (IT.GT.NNN) GO TO 1580
      IPS = 8000
      NREC = IT+NSKP
      WRITE (6,160) NREC
  160 FORMAT (/5X,'LABEL  150; START MAIN LOOP.  RECORD NO. ',I3/)
C
C      PROGRAM PERMITS TREATMENT OF A KNOWN NUMBER OF RECORDS,NN, OR
C      STOPPING WHEN ISTOP=1 ON STATION LABEL CARD. THE LABEL CARD HAS
C      TWO DIGITS FOR CONTROL. THE 77-TH COLUMN IS JSKIP; IF JSKIP=0,
C      ONLY TWO CARDS ARE READ. THE 78-TH COLUMN IS ISTOP; IF ISTOP=1,
C      THE PROGRAM STOPS. NORMAL TERMINATION OF THE PROGRAM MAY BE
C      ACCOMPLISHED IN TWO DISTINCT WAYS. EITHER SET NN TO DESIRED
C      RECORD TO STOP OR PLACE A 'STATION END' LABEL CARD AT END OF DATA
C      DECK WITH A ONE IN COLUMN 78. THE 79-TH COLUMN IS AMONC; AMONC IS
C      AN ALPHABETIC LETTER CODE FOR MONTH AND YEAR. THIS CODE IS
C      CONVERTED TO LITERAL MONTH AND YEAR LATER ON IN PROGRAM.
C
      READ (5,170) LABEL,JSKIP,ISTOP,AMONC
  170 FORMAT (19A4,2I1,A1)
      IF (ISTOP.GT.0) GO TO 1580
      READ (5,DAT)
```

```
      WRITE (6,180) LABEL
      WRITE (6,DAT)
C      NORMALLY TWO CARDS, LABEL AND DAT, ARE READ PER RECORD.
C      LESS FREQUENTLY CHANGED VARIABLES ARE ON CONTRL DATA CARD.
      JJJJ = 0
      NOIRG = 0
      IF (JSKIP.EQ.0) GO TO 190
      READ (5,CONTRL)
      WRITE (6,CONTRL)
  180 FORMAT (/5X,19A4/)
C
C
C       PROVISION IS MADE HERE FOR A MISSED HEADER LABEL ON TAPE (AN
C       OPERATOR ERROR). IF IHDR=1,AND ALL INFORMATION REQUIRED IS PLACED
C       ON PARTICULAR &DAT CARD, THE PROGRAM BRANCHES OFF TO  610 AND
C       WRITES STATION INFORMATION AND MESSAGE THAT HEADER IS MISSING,
C       AND FINALLY RETURNS TO 150 TO START NORMAL PROCESSING OF TRACE
C       RECORD DATA. NOTE, RECORD COUNT IS NOT INCREMENTED IN THIS LOOP.
C
  190 IF (IHDR.EQ.1) GO TO 610
  200 CONTINUE
C
C       NOTE: IN EARLIER VERSIONS OF THIS PROGRAM, THERE WAS AN
C       INTERPOLATION ROUTINE HERE FOR HAND-ENTERED DATA BUT IT WAS
C       DELETED SINCE VERY SELDOM ONE HAD CAUSE TO USE IT. HOWEVER, THE
C       CAPABILITY FOR HAND-ENTERED DATA HAS BEEN RETAINED BUT IN A
C       DIFFERENT FORM. SEE COMMENTS FOLLOWING STATEMENT NO. 1130.
C
C-------------------
  210 FORMAT (5X,11F7.2/5X,11F7.2/5X,11F7.2/5X,11F7.2/5X,11F7.2/5X,11F7.
     12/5X,11F7.2/5X,11F7.2/5X,3F7.2,60X,I6)
  220 FORMAT (5X,10I5,'  INSA')
  230 FORMAT (5X,10I5,'  INTA')
  240 FORMAT (5X,' KS , KS1, KS2, KT , KT1, KT2, JJJ, NE ,KDTH1,KDTH2,KD
     1TA,KDT1,JJJJ'/4X,8I5,2I6,3I5)
C-------------------
C
C-------------------
       IPLACE=245
       WRITE (6,210) (D(J),J=1,1801,20)
       WRITE (6,210) (T(J),J=1,1801,20),IPLACE
       WRITE (6,210) (S(J),J=1,1801,20),IPLACE
       WRITE (6,220) (INSA(J),J=1,10)
       WRITE (6,230) (INTA(J),J=1,10)
       WRITE (6,240) KS,KS1,KS2,KT,KT1,KT2,JJJ,NE,KDTH1,KDTH2,KDTA,KDT1,J
     1JJJ
C-------------------
C
```

```
C
C     FILL THE A ARRAY WITH DOLLARS
C
C
      DO 250 I=1,2001
C     THE 2001 ASSURES THAT THE LAST WORD OF A WILL CONTAIN DOLLARS
C     SINCE 2000 WORDS OR 8000 BYTES OF DATA ARE READ IN.
      A(I) = DOL
  250 CONTINUE
C
C
C     FILL B WITH BLANKS
C
C
      DO 260 I=1,8000
      B(I) = BLANK
  260 CONTINUE
C
C     PROGRAM EXAMINES LIST OF INDIVIDUAL BAD RECORDS,NRCSKP,AND
C     SKIPS THEM. IF NRCSKP(1)=0, THE SKIP ROUTINE IS BY-PASSED.
C     CAUTION:  DO NOT REMOVE PAIRS OF DATA CARDS FOR INDIVIDUALLY
C     SKIPPED CARDS.
C
C     IN USING THE CALMA DIGITIZER, SPURIOUS BLANK RECORDS OCCURRED
C     THROUGHOUT THE TAPE ON NUMEROUS OCCASSIONS. MANY OF THESE
C     OCCURRENCES WERE LATER TRACED TO EQUIPMENT MALFUNCTION.
C     HOWEVER, IF A BLANK RECORD OCCURS DURING A HEADER LABEL RECORD
C     NOTHING IS LOST SINCE HEADER INFO MAY BE INSERTED BY CARD AND
C     SETTING IHDR=1. ON THE OTHER HAND, IF A BLANK RECORD OCCURS
C     DURING A TRACE RECORD THE COMPLETE STATION IS LOST. FROM
C     EXPERIENCE, A BLANK RECORD WILL GENERALLY HAVE TWO CHARACTERS.
C     AFTER THE FIRST PROGRAM RUN AND A DETERMINATION OF BLANK OR
C     BAD RECORDS HAS BEEN MADE, THESE MAY BE SKIPPED INDIVIDUALLY VIA
C     NRCSKP ROUTINE.
      IF (NRCSKP(1).EQ.0) GO TO 320
C
C
C     ******************************************************************
C     *************** START INDIVIDUAL RECORD SKIP LOOP **************
C
C
      DO 270 LB=1,99
      NRC = NRCSKP(LB)-NSKP
      IF (NRC.EQ.IT) GO TO 280
  270 CONTINUE
C
      GO TO 300
  280 IPS = -8000
```

```
  290 FORMAT (//5X,'LABEL 290. RECORD NO.',I5,' SKIPPED VIA NRCSKP SKIP
     1 ROUTINE.'//)
      WRITE (6,290) IT
C     CHANGING IPS TO NEGATIVE CAUSES TPRD  TO SKIP A RECORD
  300 IF (ICODE.EQ.0) GO TO 320
      WRITE (6,310) IDEPTH,ICODE,ISCL
  310 FORMAT (5X,'SALINITY VERSUS DEPTH'/
     1 5X,'STD RECORD STARTS AT ',I3,' METERS'/
     2 5X,'CODE =  ',I2/
     3 5X,'SCALE = ',I2/)
C
C       ************************************************************
C       ******************** READ TAPE ******************************
  320 CALL TPRD (A,IPS,&350,&330)
C
C       IPS IS THE MAXIMUM NUMBER OF BYTES OF DATA WHICH WILL BE READ
C       FROM ONE RECORD OF DIGITIZER TAPE BY TPRD. IPS/2 IS THE MAXIMUM
C       TOTAL TRAVEL ALONG THE CURVE MEASURED IN 0.01 INCHES IN THE X
C       AND Y DIRECTION SEPARATELY. 350 IS THE END OF FILE EXIT, AND 330
C       IS THE READ-ERROR EXIT.
      GO TO 360
  330 WRITE (6,340) A(1),A(2),A(3),A(4)
  340 FORMAT (5X,'I10 ERROR STATISTICS TABLE IS ',4Z8)
C
  350 CONTINUE
  360 CONTINUE
C
C       ************************************************************
C       *************** END INDIVIDUAL RECORD SKIP LOOP *************
C
C       PROCESS THE LAST RECORD
C       MOVE THE BYTES OF A INTO THE 4-BYTE WORDS OF B USING CHMOVE.
      JJ = 0
      JJJ = 0
C
C
      DO 370 II=1,2000
C
C
      DO 370 I=1,4
      JJ = JJ+1
      CALL CHMOVE (A(II),I,B(JJ),4)
      IF (B(JJ).EQ.DLR) GO TO 380
C       END OF DATA DETECTED
C       THERE MAY BE A STAR BEFORE THE DOLLAR
  370 CONTINUE
C
C
```

```
  380 CONTINUE
      B(8001) = DLR
C
C       ****************************************************************
C       ***************** PREPARE TO PROCESS RAW ARRAY *****************
C
      WRITE (6,390) JJ,(B(J),J=1,25)
  390 FORMAT (/5X,'LABEL 390.  ARRAY B IS FILLED; LOOK FOR MODE CHARACTE
     1R.  THE NUMBER OF ARRAY ELEMENTS PROCESSED INCLUDING STARS AND '/
     2 5X,'DOLLARS, JJ= ',I5,/5X,'FIRST  25 CHARACTERS ARE: ',
     3 10(1X,Z8)/5X,10(1X,Z8)/5X,5(1X,Z8)/)
C
C     ******************************************************************
C
      JJ = 1
      GO TO 430
C
C       ****************************************************************
C       ****************** START MISSING IRG ROUTINE *******************
C
C       THE FOLLOWING ROUTINE READS ANOTHER SET OF CARDS.  THIS IS THE
C       ENTRY FOR THE SITUATIONS IN WHICH THE IRG IS MISSED.
  400 READ (5,170) LABEL,JSKIP,ISTOP,AMONC
      IF (ISTOP.GT.0) GO TO 1580
      IF (JSKIP.EQ.0) GO TO 410
      READ (5,DAT)
      WRITE (6,180) LABEL
      WRITE (6,DAT)
      READ (5,CONTRL)
      WRITE (6,CONTRL)
C-----------------
  410 IPLACE=410
      WRITE (6,210) (D(J),J=1,1801,20)
      WRITE (6,210) (T(J),J=1,1801,20),IPLACE
      WRITE (6,210) (S(J),J=1,1801,20),IPLACE
      WRITE (6,220) (INSA(J),J=1,10)
      WRITE (6,230) (INTA(J),J=1,10)
      WRITE (6,240) KS,KS1,KS2,KT,KT1,KT2,JJJ,NE,KDTH1,KDTH2,KDTA,KDT1,J
     1JJJ
      WRITE (6,420) NOIRG,JJJJ
  420 FORMAT (/5X,'LABEL 410.  PROCESSING SECOND HALF.  NOIRG=',I3,
     1 'JJJJ=',I5/)
C-----------------
      NOIRG = 0
      JJ = JJJJ
C
C       ****************************************************************
C       *******************END MISSING IRG ROUTINE *********************
```

```
C
C      INITIALIZE ADDERS,ETC.
  430 SUMD = 0.
      SUMD = 0.
      SUMT = 0.
      N = 0
      KL = 0
      KK = 0
C
C       *****************************************************************
C       ********************** MODE SYMBOL CHECK **********************
C
  440 IF (B(JJ).EQ.KEY) GO TO 490
C       THE FIRST ELEVEN VALUES OF THE B-ARRAY ARE CHECKED FOR A
C       KEYBOARD SYMBOL SINCE IT IS POSSIBLE TO HAVE GARBAGE VALUES AHEAD
C       OF THE KEYBOARD SYMBOL. IF ALL ELEVEN VALUES ARE NOT KEYS
C       THEN JJ IS RESET TO 1 AND THE RECORD IS PROCESSED AS A TRACE.
C       HOWEVER, IF ONE OF THE ELEVEN VALUES ARE A KEY, PROGRAM BRANCHES
C       TO 490, AND PROCESSES AS A HEADER. AT FIRST GLANCE, THIS
C       PROCEDURE APPEARS TO ASSUME THAT IT IS IMPOSSIBLE TO HAVE A
C       KEY SYMBOL APPEAR IN THE FIRST ELEVEN CHARACTERS OF A TRACE
C       RECORD. THIS IS NOT A BAD ASSUMPTION SINCE THE OPERATOR HAS TO
C       GO OUT OF HIS WAY TO INITIATE KEYBOARD MODE DURING TRACE MODE.
C       HOWEVER, LEAVING NOTHING TO CHANCE THE PROGRAM WILL KEEP
C       CHECKING FOR KEY OR TRACER UNTIL OPERATOR MAKES UP HIS MIND
C       WHICH MODE IS CORRECT. IF NO TRACER SYMBOLS APPEAR AFTER PROGRAM
C       FINDS A KEY, THEN RECORD WILL BE PROCESSED AS A HEADER. ON THE
C       OTHER HAND, IF NO KEY SYMBOLS APPEAR AFTER PROGRAM FINDS A TRACER
C       THEN THE RECORD WILL BE PROCESSED AS A TRACE.
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
```

```
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ-10
      IF (KL.EQ.1) GO TO 500
      IF (KL.EQ.2) GO TO 500
C      NO KEYBOARD SYMBOL; MAY HAVE FORGOTTEN IT. TEST THE 5TH AND
C      6TH SYMBOLS (IDEPTH).  IF BOTH ARE NINES CALL IT A KEYBOARD.
      IF (B(5).EQ.NINE.AND.B(6).EQ.NINE) GO TO 450
      GO TO 670
  450 IJJ = JJ+12
      WRITE (6,460) (B(I),I=JJ,IJJ)
  460 FORMAT (/5X,'AT 450, MISSING KEY.  B(1) TO B(13)=',13A1/)
      GO TO 500
C
  470 WRITE (6,480)
  480 FORMAT (5X,'FOUND EIGHT KEYBOARD SYMBOLS IN SEQUENCE.   STOP.')
      GO TO 1570
  490 KL = KL+1
      JJ = JJ+1
C      A CHECK IS MADE HERE FOR MULTIPLE KEYBOARD SYMBOLS. IF NUMBER
C      EXCEEDS EIGHT, PROGRAM TERMINATES. THE NUMBER EIGHT IS ARBITRARY
C      BUT ONE WOULD PROBABLY NOT WANT TO USE A NUMBER GREATER THAN 12
C      (IE. ONE LESS THAN NUMBER OF CHARACTERS IN HEADER). EXPERIENCE
C      INDICATES THAT SELDOM DOES ONE INCUR MORE THAN THREE KEYBOARD
C      SYMBOLS ON A TAPE PER RECORD.
      IF (KL.EQ.8) GO TO 470
      IF (B(JJ).EQ.STAR) GO TO 670
C      TRY AGAIN
      GO TO 440
C
C      ****************************************************************
C      ****************** START KEYBOARD DECODE ******************
C
C      PROCESS KEYBOARD ENTRIES.  CHANGE THE WORDS TO
C      INTEGER FORM BY SUBTRACTING Z404040F0 AND CREATE MULTI-DIGIT
C      INTEGERS
C      SKIP=T PERMITS NAMELIST DATA TO OVERRIDE HEADING DATA.  ALL THE
C      HEADING DATA MUST THEN BE ON THE NAMELIST CARDS.
  500 IF (SKIP) GO TO 610
      ISTAA = 0
      IDEPT = 0
C      DEFINE INDICES FOR DECODING THE LABEL
      KY1 = JJ
      KY2 = KY1+2
      KY3 = KY1+3
      KY4 = KY1+4
      KY5 = KY1+5
      KY6 = KY1+6
      KY7 = KY1+7
```

```
      KY8 = KY1+8
      KY9 = KY1+9
      KY10 = KY1+10
      KY11 = KY1+11
C
C      DLTREC ARE FOJND HERE IN THE HEADER.  IF DLTREC OCCURS , READ IN
C      A NEW RECORD AND USE SAME CARDS.
C
C
      DO 510 J=KY1,KY10
      IF (B(J).EQ.DLTREC) GO TO 520
  510 CONTINUE
C
C
      GO TO 550
  520 WRITE (6,530)
  530 FORMAT (/5X,'DLTREC IN HEADER. REPEAT,USING SAME CARDS.'/)
  540 IT = IT+1
      GO TO 200
  550 KT2 = 10
      KS2 = 10
C      THESE TWO STATEMENTS GIVE MAXIMUM VALUES TO KT2 AND KS2 SO THAT
C      THEY WILL ALWAYS BE DEFINED, EVEN IF  ONLY ONE VARIABLE IS TRACED
C
C      DO THE CONVERSION, COMPARE WITH VALUES READ FROM THE CARDS,ACCEPT
C      THE CARDS.
C
C
      DO 560 J=KY1,KY2
      B(J) = B(J)-ZER
      IB = B(J)
      ISTAA = ISTAA+IB*10**(KY2-J)
  560 CONTINUE
C
      AMONT = B(KY3)
C
C
      DO 570 J=KY4,KY5
      B(J) = B(J)-ZER
      IB = B(J)
      IDEPT = IDEPT+IB*10**(J-KY4)
  570 CONTINUE
C
      IDSC = B(KY6)-ZER
      ICOD = B(KY7)-ZER
      ITSCL1 = B(KY8)-ZER
      ISCL1 = B(KY9)-ZER
      IPP = B(KY10)-ZER
```

```
C
C       IF THERE IS A DISAGREEMENT, WRITE A MESSAGE.
      IF (ISTAA.NE.ISTA) GO TO 590
      IF (IDEPT.NE.IDEPTH) GO TO 590
      IF (IDSC.NE.IDSCL) GO TO 590
      IF (ICOD.NE.ICODE) GO TO 590
      IF (ITSCL1.NE.ITSCL) GO TO 590
      IF (ISCL1.NE.ISCL) GO TO 590
      IF (IPP.NE.IP) GO TO 590
  580 FORMAT (5X,'LABEL= 580.  CARD INPUTS EQUALLED TAPE HEADER FOR
     1 STATION ',I3,A1/5X,'IDEPTH= ',I3/)
      WRITE (6,580) ISTA,AMONC,IDEPTH
      GO TO 610
  590 WRITE (6,600) ISTA,AMONC,IDEPTH,IDSCL,ICODE,ITSCL,ISCL,IP,ISTAA,AM
     1ONT,IDEPT,IDSC,ICOD,ITSCL1,ISCL1,IPP
  600 FORMAT (/3X'CARD AND TAPE DISAGREE, CARD ON TOP'/3X,'   ISTA  AMON
     1C   IDEPTH  IDSCL  ICODE  ITSCL   ISCL    IP'/3X,I7,A7,6I7/3X,I7
     2 ,A7,6I7/)
C       WRITE THE RESULTS
  610 WRITE (6,620) ISTA,AMONC,IDEPTH
  620 FORMAT (5X,'LABEL 610.  HEADER PROCESSING COMPLETE EXCEPT SEARCH F
     1OR ERRORS ON STATION ',I3,A1/5X,'IDEPTH= ',I3/)
C
C
C       IT IS POSSIBLE THAT NO IRG EXISTS AFTER THE HEADER.IF SO,
C       THE PROGRAM HAS FILLED THE B ARRAY WITH BOTH THE HEADER AND TEMP.
C       OR SALINITY TRACE. ASSUME THERE IS A TRACER SYMBOL IN POSITION
C       12. IF SO, CONTINUE TO PROCESS THE B-ARRAY
      IF (B(KY11).NE.STAR) GO TO 640
      JJJJ = KY11
      WRITE (6,630)
  630 FORMAT (/5X,'NO IRG AFTER HEADER; CONTINUE TO PROCESS B ARRAY.'/)
      GO TO 400
  640 IF (IHDR.EQ.0) GO TO 660
C
C       THIS BRANCH RETURNS TO 150 IF MISSED HEADER AND IHDR SET EQUAL 1.
      WRITE (6,650)
  650 FORMAT (/5X,'HEADER MISSING; INFO INSERTED WITH CARDS.'/)
      IHDR = 0
      GO TO 150
  660 CONTINUE
      GO TO 1550
C       ****************************************************************
C       ********************** END KEYBOARD DECODE ********************
C
C
C       ****************************************************************
C       ***************** START OF NORMAL TRACE PROCESSING ************
```

```
C
C        THE FOLLOWING PROCEDURE PERMITS THE PRESENCE OF ANY REASONABLE
C        NUMBER OF TRACER SYMBOLS (STAR) INCLUDING NONE.
  670 NE = 0
      NF = 0
      NSTAR = 0
  680 IF (B(JJ).EQ.STAR) GO TO 700
C
C        COUNT STARS AND WRITE MESSAGE
      WRITE (6,690) NSTAR
  690 FORMAT (/5X,'START TRACER MODE; NO. OF TRACER SYMBOLS =',I2/)
C        WHEN THERE ARE NO MORE STARS, START TESTING FOR COUNT SYMBOLS ETC
      GO TO 710
  700 JJ = JJ+1
      NSTAR = NSTAR+1
C        WE CONTINUE TO TEST FOR STARS UNTIL NO MORE APPEAR.
      GO TO 680
C
C        THE NEXT BLOCK OF OPERATIONS TO STATEMENT NO. 950 LOOPS BACK TO
C        710 CONTINUALLY, TESTING EACH CHARACTER FOR IDENTITY AND
C        CONTINUING TO ADD OR SUBTRACT FROM THE CUMULATIVE Y AND X COUNTS
C        UNTIL A DELETE-RECORD SYMBOL OR A STAR OR A DOLLAR INDICATES
C        THE END OF DATA.  THE FLAG IS PLACED AT THE POINT WHERE THE TRACE
C        ENTERS THE CROSS-SECTIONED AREA; PREVIOUS COUNTS RESULT FROM THE
C        TRACER TRAVELLING FROM THE COORDINATE ZERO TO THIS POINT.
  710 IF (B(JJ).EQ.ONE) GO TO 730
      IF (B(JJ).EQ.BLANK) GO TO 740
      IF (B(JJ).EQ.MINUS) GO TO 750
      IF (B(JJ).EQ.FLAG) GO TO 900
C        THE NEXT GROUP OF STATEMENTS ALLOW FOR OCCASIONAL COUNTS GREATER
C        THAN + OR - 1.
      IF (B(JJ).EQ.TWO) GO TO 760
      IF (B(JJ).EQ.THREE) GO TO 770
      IF (B(JJ).EQ.FOUR) GO TO 780
      IF (B(JJ).EQ.FIVE) GO TO 790
      IF (B(JJ).EQ.SIX) GO TO 800
      IF (B(JJ).EQ.SEVEN) GO TO 810
      IF (B(JJ).EQ.EIGHT) GO TO 820
      IF (B(JJ).EQ.NINE) GO TO 830
      IF (B(JJ).EQ.TEN) GO TO 840
      IF (B(JJ).EQ.ELEVEN) GO TO 850
      IF (B(JJ).EQ.MTWO) GO TO 860
      IF (B(JJ).EQ.MTHREE) GO TO 870
      IF (B(JJ).EQ.MFOUR) GO TO 880
      IF (B(JJ).EQ.MFIVE) GO TO 890
      IF (B(JJ).EQ.DLTREC) GO TO 970
      IF (B(JJ).EQ.KEY) GO TO 440
  720 FORMAT (//5X,'SYMBOL NOT RECOGNIZED = ',Z8//)
```

```
      WRITE (6,720) B(JJ)
C       IF SYMBOL IS NOT RECOGNIZED, STATION DATA IS NOT PRINTED IF IP=1.
C       PROGRAM BRANCHES AND RE-INITIALIZES ALL VARIABLES FOR PROCESSING
C       NEXT STATION IF IP=1. OTHERWISE, IT RETURNS TO READ NEXT RECORD.
      IF (IP.EQ.1) GO TO 1510
      GO TO 1570
  730 RX = 1.
      GO TO 910
  740 RX = 0.
      GO TO 910
  750 RX = -1.
      GO TO 910
  760 RX = 2.
      GO TO 910
  770 RX = 3.
      GO TO 910
  780 RX = 4.
      GO TO 910
  790 RX = 5.
      GO TO 910
  800 RX = 6.
      GO TO 910
  810 RX = 7.
      GO TO 910
  820 RX = 8.
      GO TO 910
  830 RX = 9.
      GO TO 910
  840 RX = 10.
      GO TO 910
  850 RX = 11.
      GO TO 910
  860 RX = -2.
      GO TO 910
  870 RX = -3.
      GO TO 910
  880 RX = -4.
      GO TO 910
  890 RX = -5.
      GO TO 910
  900 JJJ = NE
      JJ = JJ+1
      FG = 1
      GO TO 710
C
C       PROGRAM ADDS AND STORES CUMULATIVE SUMS. ONE UNIT EQUALS 0.01
C       INCH.
  910 N = N+1
```

```
      NE = N/2
      NF = NE*2
      IF (NF.EQ.N) GO TO 920
C      THIS FIDDLING AROUND DETERMINES IF THE COUNT IS EVEN OR ODD.
C      START COUNTING IN THE ORDER YXYX.  X AND Y HAVE NORMAL
C      ORIENTATIONS ON THE STRIP CHART. HOWEVER, X AND Y ARE INVERTED
C      WITH RESPECT TO THE CALMA DIGITIZER. SPECIFICALLY, DEPTH
C      INCREASES ALONG THE POSITIVE X-AXIS AND TEMP AND SALINITY ARE
C      INCREASING FUNCTIONS ALONG THE Y-AXIS ON THE CALMA DIGITIZER.
C      WARNING: DIGITIZE TRACES ACCORDING TO ABOVE ORIENTATION OR BE
C      PREPARED TO RE-DIGITIZE TAPE LATER AFTER DISCOVERING GOOF.
C
C      IF ODD
      SUMD = SUMD+RX
C      ODD INDEX IS INCREASED TO KEEP IT SAME AS EVEN.
      NE = NE+1
      Y(NE) = SUMD
      JJ = JJ+1
      GO TO 930
C      IF EVEN
  920 SUMT = SUMT+RX
      X(NE) = SUMT
      JJ = JJ+1
C      IF STAR OR DOLLAR FOUND, END OF DATA HAS BEEN REACHED.
  930 IF (B(JJ).EQ.DLR) GO TO 990
C      ************************************************************
C      ***************** END OF NORMAL TRACE PROCESSING ****************
C
C
C      ************************************************************
C      ********************* BEGIN TROUBLE-SHOOTING *******************
C      IF THERE IS NO IRG AT END OF HEADER BUT THERE IS A TRACER SYMBOL,
C      THE PROGRAM SEPARATES THE TWO RECORDS BY FIRST SETTING NOIRG=1
C      AND PROCESSING FIRST PART OF B-ARRAY AND THEN READING A NEW SET
C      OF CARDS TO PROCESS SECOND PART OF B-ARRAY.
      IF (B(JJ).NE.STAR) GO TO 950
      NOIRG = 1
C      SAVE THE INDEX OF THE START OF THE SECOND HALF, JJJJ.
      JJJJ = JJ
      WRITE (6,940)
  940 FORMAT (/5X,'FOUND A STAR AT END OF TRACER ASSUME THERE IS NO IRG.
     1'/5X,'PROCESS RECORD IN TWO PARTS, READING CARDS FOR BOTH PARTS.'/
     2)
      GO TO 990
  950 IF (B(JJ).NE.KEY) GO TO 710
      JJJJ = JJ
      WRITE (6,960)
  960 FORMAT (/5X,'FOUND A KEYBOARD SYMBOL.  PROCESS NEXT PORTION OF B-A
```

```
     1RRAY AFTER READING NEW CARDS.'/)
      NOIRG = 1
      GO TO 990
C
  970 WRITE (6,980) JJ
  980 FORMAT (5X,'FOUND DELETE RECORD SYMBOL AT JJ= ',I5)
C       IF DELETE RECORD FOUND, PROGRAM INCREMENTS RECORD COUNT,IT,
C       AND RESTARTS PROCESSING BUT DOES NOT READ A NEW PAIR OF CARDS.
      GO TO 540
  990 JJ = JJ-1
C
C       ***************************************************************
C       ********** END TRACER AND ASSOCIATED TROUBLE-SHOOTING **********
C
C       UP TO THIS POINT, PROCESSING IS IDENTICAL FOR S AND T.
C       START CONVERTING T AND D TO SCIENTIFIC UNITS
      WRITE (6,1000) JJJ,NE,Y(NE),X(NE)
 1000 FORMAT (/5X,'LABEL 1000. START CONDENSING UNCONVERTED ARRAY AND CO
     1NVERTING TO SCIENTIFIC UNITS.'/5X,'THE TRACER ENTERED THE FRAME (F
     2LAG) AT JJJ= ',I5/5X,'THE END OF THE TRACE HAS INDEX NE= ',I5/
     3 5X,'LAST (UNCONVERTED) DEPTH AND TEMP ARE: ',F7.1,2X,F7.1/)
C
C
C       CHECK TO SEE IF FLAG WAS FOUND.
      IF (FG.EQ.1) GO TO 1020
      WRITE (6,1010)
 1010 FORMAT (/5X,'NO FLAG FOUND; PROCESS ANYWAY.'/)
 1020 WRITE (6,1030)
 1030 FORMAT (' ')
      FG = 0
C
C       THE X AND Y ARRAYS ARE FILLED AND THE START AND END OF THIS BATCH
C       OF DATA ARE LABELLED WITH JJJ AND NE.
C       CONVERT THE ARRAYS INDEXED ON 0.01-INCH DEPTH SPACINGS.
C       SUBROUTINE CONDNS SERVES THIS PURPOSE ALTHOUGH IT NO LONGER
C       CONDENSES  A SECOND ARRAY TO SMALLER SIZE, NOR DOES IT PAD THE
C       GAP BETWEEN ARRAYS, BUT WITHIN ONE SEGMENT, IT DOES INTERPOLATE
C       TO FILL ANY BLANK ARRAY POSITIONS.
C
C
C       TO THOSE FAMILIAR WITH EARLIER VERSIONS OF THIS PROGRAM, THE
C       FOLLOWING CONDENSE ROUTINES WILL NOT EVEN APPEAR REMOTELY
C       SIMILAR. THE EARLIER VERSION HAD TO BE EXTENSIVELY MODIFIED
C       TO PERMIT MULTIPLE DEPTH SCALES. SPECIFICALLY, WHEN USING
C       MULTIPLE DEPTH SCALES ONE'S DEPTH AXIS REFERENCE CHANGES AND
C       CONSEQUENTLY IN CONSTRUCTING THE S AND D OR T AND D ARRAYS
C       THIS ROUTINE WORKS WELL.
      IF (ICODE.EQ.0) GO TO 1080
```

```
C   *                                                                      *
C   S**********************************************************************S
C        CONDENSE THE X AND Y ARRAYS INTO S AND D
C   S**********************************************************************S
C   *                                                                      *
      KS = KS+2
      KS1 = KS-1
      KS2 = KS+1
      IF (IDSCL.EQ.1) GO TO 1040
      KDT1 = KSCARF+1
      GO TO 1050
 1040 KDT1 = INSA(KS1)
 1050 CALL CONDNS (X,Y,S1,JJJ,NE,KDT1,KDTH1,KDTH2)
      KDTA = KDTH1+1
      K = KDTH1
      IF (IDSCL.EQ.1) GO TO 1060
      K = KDT1
C
C
 1060 DO 1070 J=KDTH1,KDTH2
      D(K) = (J-1)/DCON(IDSCL)+CORD
      S(K) = S1(J)/SCON+CORRS(ISCL)+SCOR
      K = K+1
      KSCARF = K
 1070 CONTINUE
C
C
      INSA(KS) = KDTH1
      INSA(KS2) = KDTH2
      GO TO 1130
C   *                                                                      *
C   T**********************************************************************T
C        CONDENSE THE X AND Y ARRAYS INTO T AND D
C   T**********************************************************************T
C   *                                                                      *
 1080 KT = KT+2
      KT1 = KT-1
      KT2 = KT+1
      IF (IDSCL.EQ.1) GO TO 1090
      KDT1 = KBARF+1
      GO TO 1100
 1090 KDT1 = INTA(KT1)
 1100 CALL CONDNS (X,Y,T1,JJJ,NE,KDT1,KDTH1,KDTH2)
      KDTA = KDTH1+1
      K = KDTH1
      IF (IDSCL.EQ.1) GO TO 1110
      K = KDT1
C
```

```
C
 1110 DO 1120 J=KDTH1,KDTH2
      D(K) = (J-1)/DCON(IDSCL)+CORD
      T(K) = T1(J)/TCON+CORRT(ITSCL)+TCOR
      K = K+1
      KBARF = K
 1120 CONTINUE
C
C
      INTA(KT) = KDTH1
      INTA(KT2) = KDTH2
C  *                                                                       *
C  T***********************************************************************T
 1130 CONTINUE
C
C       *******************************************************************
C       ********************** HAND-ENTERED DATA **********************
C
C       CONVERSION OF X AND Y ARRAYS INTO T AND S ARRAYS IS COMPLETE.
C       AT THIS POINT, SURFACE AND NEAR-SURFACE DATA WILL BE INSERTED.
C       NORMALLY, ONLY SURFACE VALUES NEED TO BE INSERTED DUE TO THE
C       DIGITIZER OPERATOR BEGINNING TO TRACE SLIGHTLY BELOW HIS ZERO
C       DEPTH REFERENCE POINT. SURFACE DATA VALUES ARE INSERTED BY
C       CHECKING THE VALUE OF IH. IF IH=0, DATA IS NOT INSERTED. IF IH=1,
C       SURFACE DEPTH,TEMP, AND SALINITY VALUES ARE INSERTED VIA &DAT
C       DATA CARD FOR PARTICULAR STATION.
C       CAUTION: HAND-ENTERED DATA VALUES SHOULD BE CORRECTED VALUES
C       IF CORRECTIONS,TCOR AND SCOR, ARE APPLICABLE.
C       INFREQUENTLY, DATA VALUES BELOW THE SURFACE MUST BE INSERTED.
C       PROVISION IS MADE FOR NEAR-SURFACE DEPTHS DOWN TO APPROXIMATELY
C       15 METERS. THIS OCCURS DUE TO THE SAME REASON AS ABOVE(IE. A NOT
C       SO METICULOUS OPERATOR BEGAN DIGITIZING BELOW ZERO REFERENCE
C       POINT.). SINCE THIS OCCURS SELDOM, AND INVOLVES A SIGNIFICANT
C       AMOUNT OF LABOR TO MANUALLY READ THE STD TRACE, CORRECT THE
C       VALUES IF NEEDED AND PLACE ON &DAT CARD, THIS OPERATION WILL
C       ONLY BE DONE FOR FINAL OUTPUT TO TAPE,CARD OR PRINTER.
C       CONSEQUENTLY, TO INSERT NEAR-SURFACE DATA ISQZ MUST EQUAL 1,
C       IH MUST BE GREATER THAN OR EQUAL TO 2. DH,TH, AND SH WERE
C       DIMENSIONED AT 50. THIS EQUATES TO APPROXIMATELY 15 METERS.
C       ISQZ=1 WAS CHOSEN AS DETERMINING VALUE DUE ALL ELEMENTS OF D,T,
C       AND S ARRAYS ARE PRINTED OUT VIA OUT1. THIS ELIMINATES
C       'GUESSWORK' OF WHICH VALUES SHOULD BE INSERTED. IN OTHER WORDS,
C       ALL OF THEM ARE INSERTED.
      IF (IH.EQ.0) GO TO 1150
      S(1) = SH(1)
      T(1) = TH(1)
      IF (IH.LT.2) GO TO 1150
      IF (ISQZ.GT.1) GO TO 1150
```

```
C
C
      DO 1140 J=2,IH
      S(J) = SH(J)
      T(J) = TH(J)
      D(J) = DH(J)
 1140 CONTINUE
C
C
 1150 CONTINUE
C  *                                                                    *
C--------------------
      IPLACE=1155
      WRITE (6,210) (D(J),J=1,1801,20)
      WRITE (6,210) (T(J),J=1,1801,20),IPLACE
      WRITE (6,210) (S(J),J=1,1801,20),IPLACE
      WRITE (6,220) (INSA(J),J=1,10)
      WRITE (6,230) (INTA(J),J=1,10)
      WRITE (6,240) KS,KS1,KS2,KT,KT1,KT2,JJJ,NE,KDTH1,KDTH2,KDTA,KDT1,J
     1JJJ
C--------------------
C
      IF (IP.EQ.1) GO TO 1160
      IF (NOIRG.EQ.1) GO TO 400
      GO TO 1570
 1160 IN1 = KBARF
      IN2 = KSCARF
      KDTA = MINO(IN1,IN2)
 1170 FORMAT (5X,'LABEL=1170.',3I7//)
      WRITE (6,1170) IN1,IN2,KDTA
C       ****************************************************************
C       ********** EDITING OF UNWANTED ZERO DATA VALUES ****************
C
C       IN DIGITIZING TEMP AND SALINITY SEGMENTS OF TRACES ONE CAN NOT
C       AVOID GETTING GAPS SOMETIMES BETWEEN TRACE SEGMENTS. WHEN THIS
C       HAPPENS THE OUTPUT PRINTOUT WILL SHOW -5.0 AND 0.0 FOR THE
C       TEMPERATURE AND SALINITY VALUES RESPECTIVELY. THESE VALUES ARE
C       THE PRE-INITIALIZED VALUES OF THE T AND S ARRAYS, AND INDICATE
C       NO ATTEMPT HAS BEEN MADE TO PLACE DATA IN THE PARTICULAR ARRAY
C       POSITION (IE A GAP IN DATA). IT IS DESIRABLE THAT THESE UNWANTED
C       VALUES OR GAPS BE ELIMINATED PRIOR TO WRITING A TAPE OR PUNCHING
C       A CARD. THUS A CHECK IS MADE TO SEE IF T(J) OR S(J) ARE -5.0 OR
C       0.0 RESPECTIVELY. IF T(J) AND S(J) ARE NOT -5.0 OR 0.0
C       RESPECTIVELY, THE VALUES ALONG WITH DEPTH ARE PLACED INTO D2,T2,
C       AND S2 ARRAYS. IF GAPS DO EXIST, THE VALUES ARE WRITTEN OUT AND
C       COUNTED BUT NOT PUT INTO THE D2,T2,AND S2 ARRAYS.  THIS PROCESS
C       IN EFFECT DISCARDS THE GAPS IN THE DATA. THE D,T, AND S ARRAYS
C       ARE THEN RE-INITIALIZED, AND THE D2,T2,AND S2 ARRAYS ARE PUT BACK
```

```
C        INTO THE D,T,AND S ARRAYS. NOTE, THE VALUE OF KDTA WHICH
C        IS EQUAL TO TOTAL NUMBER OF RECORDS IS REDUCED BY NUMBER OF
C        UNWANTED RECORDS BY MAKING USE OF THE VARIABLE KDTAF.
      K = 0
      L = 1
C
C
      DO 1200 J=1,KDTA
      IF ((T(J).EQ.-5.0).OR.(S(J).EQ.0.0)) GO TO 1180
      D2(L) = D(J)
      T2(L) = T(J)
      S2(L) = S(J)
      L = L+1
      GO TO 1200
 1180 WRITE (6,1190) D(J),T(J),S(J),J
      K = K+1
      JSAV = K
 1190 FORMAT (//5X,3F7.2,I6,//)
 1200 CONTINUE
C
C
 1210 FORMAT (//5X,' JSAV=',I6,//)
      WRITE (6,1210) JSAV
      KDTAF = KDTA-JSAV
      KDTA = KDTAF
C
C
      DO 1220 J=1,1801
      D(J) = 0.0
      T(J) =-5.0
      S(J) = 0.0
 1220 CONTINUE
C
C
C
C
      DO 1230 J=1,KDTA
      D(J) = D2(J)
      T(J) = T2(J)
      S(J) = S2(J)
 1230 CONTINUE
C
C
C       ***************************************************************
C       ****************** SOUND VELOCITY AND SIGMA-T ****************
C
C       PRODUCE SOUND VELOCITY AND SIGMA-T WHEN IP.EQ.1
      CALL SVEL (D,T,S,SV,KDTA)
```

```
      CALL SIGMT (S,T,SIG,KDTA)
C
C      ******************************************************************
C      *********** CONSECUTIVE RECORD SERIALIZATION ROUTINE ***********
C
C      ARRAYS ARE COMPLETE AT THIS POINT FROM INDEX 1 TO THE END OF
C      THE SMALLER OF THE SALINITY OR TEMPERATURE ARRAYS.
C      GENERATE SERIAL NUMBERS FOR THE RECORDS.
      IF (JREC.GT.18) GO TO 1240
      JREC = 1
 1240 CONTINUE
C
C
      DO 1250 J=1,KDTA
      JREC = JREC+1
      IREC(J) = JREC
 1250 CONTINUE
C
C
C      ******************************************************************
C      **********************  O U T P U T  *************************
C
C
C      THIS SECTION CONVERTS THE LETTER DESIGNATOR FOR MONTH(AMONC) FROM
C      THE SINGLE LETTER CODE ON THE DIGITIZED TAPE TO THE APPROPRIATE
C      MONTH AND YEAR IN PREPARATION FOR WRITING THE OUTPUT.
C
C
      DO 1260 J=1,13
      IF (AMONC.EQ.AMONCA(J)) GO TO 1280
 1260 CONTINUE
C
C
 1270 FORMAT (15X,'AMONC NEVER DID EQUAL AMONC(J).  CONSEQUENTLY,
     1WMONTH WILL NOT BE DEFINED.'/)
      WRITE (6,1270)
      GO TO 1290
 1280 WMONTH = EVENT(J)
 1290 CONTINUE
C
C      ******************************************************************
C      ************** OCEANOGRAPHIC DATA STATION SUMMARIES *************
C
      IF (.NOT.PRT1) GO TO 1300
C
C      PRINT DATA
      WRITE (6,1560)
C      THE PARAMETER ISQZ PERMITS CONDENSING THE PRINTED DATA BY THE
```

```
C        FACTOR ISQZ
      CALL OUT1 (D,T,S,SV,SIG,KDTA,ISTA,WMONTH,IREC,JREC,ISQZ)
C
C        ****************************************************************
C        *************************** WRITE TAPE ***************************
C
 1300 IF (.NOT.TAPE) GO TO 1340
C        TAPE MUST BE TRUE ONLY ONCE, AT THE BEGINNING OF TAPE  WRITING.
C        WRITE HEADER STATION LABEL HERE.
      WRITE (8,1310) ISTA,WMONTH,KDTA
 1310 FORMAT (I5,A12,I6,17X)
      WRITE (8,1320) (D(J),T(J),S(J),SV(J),SIG(J),J=1,KDTA)
 1320 FORMAT (F6.2,2F6.3,F7.2,F7.4,8X)
C        LRECL WILL BE 40 DIGITS IN LENGTH. PROVIDE APPROPRIATE JCL.
      WRITE (6,1330) ISTA,WMONTH,JREC
 1330 FORMAT (5X,'DATA FOR STATION ',I5,A12,' WRITTEN ON TAPE UP TO
     1 RECORD ',I6)
C
C        ****************************************************************
C        ****************** DATA CARD PUNCH ROUTINE ******************
C
 1340 IF (.NOT.CARDS) GO TO 1430
C
C        PUNCHED DATA IS COMPRESSED BY FACTOR ICSQZ. FORMAT FOR TWO
C        DATA SETS ON A CARD.  KCRD BECOMES THE NUMBER OF DATA PRINTED IF
C        IT IS EVENLY DIVISIBLE. OTHERWISE, LAST DATUM POINT IS PUNCHED.
C        SUPPLY JCL FOR CARD PUNCHING
      KCRD = KDTA/ICSQZ
      NCRDS = KCRD/2
      IDIF = KCRD-2*NCRDS
      IF (IDIF.EQ.0) GO TO 1360
      KCRD = KCRD+1
 1350 FORMAT (24X,'OCEANOGRAPHIC DATA FROM U C M II',//)
 1360 WRITE (7,1350)
      WRITE (7,1370) KCRD,ISTA,WMONTH,ICSQZ
 1370 FORMAT (1X,I4,' VALUES OF D,T,S,SV,SIGMT FOR STATION ',I4,A12,
     1 '  COMPRESSED BY  ',I3,/)
 1380 FORMAT (2X,'DEPTH',3X,'TEMP.',1X,'SALNTY.',1X,'SND.VEL.',1X,
     1 'SIGMA-T',3X,'DEPTH',2X,'TEMP.',1X,'SALNTY.',1X,'SND.VEL.',1X,
     2 'SIGMA-T')
 1390 FORMAT (2X,'METERS',2X,'DEG.C.',1X,'PPT.',4X,'M/SEC',13X,'METERS',
     1 1X,'DEG.C.',1X,'PPT.',4X,'M/SEC',10X,/)
      WRITE (7,1380)
      WRITE (7,1390)
      ICS2 = ICSQZ*2
      J = 1
      K1 = 1
      KK = ICSQZ
```

```
1400 FORMAT (1X,3F7.2,F9.2,F8.3,3X,3F7.2,F9.2,F8.3)
     WRITE (7,1400) D(K1),T(K1),S(K1),SV(K1),SIG(K1),D(KK),T(KK),S(KK),
    1SV(KK),SIG(KK)
     J = 3
1410 IF (J.GT.NCRDS) GO TO 1420
     K1 = (J-1)*ICS2
     KK = K1+ICSQZ
     WRITE (7,1400) D(K1),T(K1),S(K1),SV(K1),SIG(K1),D(KK),T(KK),S(KK),
    1SV(KK),SIG(KK)
     J = J+1
     GO TO 1410
1420 IF (IDIF.EQ.0) GO TO 1430
     K1 = KDTA
     WRITE (7,1400) D(K1),T(K1),S(K1),SV(K1),SIG(K1)
C
C     ****************************************************************
C     **************** HYDROGRAPHIC PROGRAM CARD PUNCH ****************
C
1430 IF (.NOT.GCARDS) GO TO 1500
     GCRD = KDTA/IGSQZ
     WRITE (7,1350)
1440 FORMAT (1X,I4,' VALUES OF D , T , AND S  FOR STATION ',I4,A12,
    1 '  COMPRESSED BY  ',I3,/)
     WRITE (7,1440) GCRD,ISTA,WMONTH,IGSQZ
1450 FORMAT (2X,'DEPTH',7X,'TEMP.',4X,'SALINITY',15X,'STATION',4X,'DATE
    1',5X,'VALUE',9X)
1460 FORMAT (2X,'METERS',6X,'DEG.C.',5X,'PPT.',51X,/)
     WRITE (7,1450)
     WRITE (7,1460)
     J = 1
     K1 = 1
1470 FORMAT (1X,F7.1,2X,F9.2,1X,F10.3,18X,I3,A12,'  K1=',I4,I8)
     WRITE (7,1470) D(K1),T(K1),S(K1),ISTA,WMONTH,K1,J
     J = 2
1480 K1 = (J-1)*IGSQZ
     IF (K1.GE.KDTA) GO TO 1490
     WRITE (7,1470) D(K1),T(K1),S(K1),ISTA,WMONTH,K1,J
     J = J+1
     IF (J.GE.500) GO TO 1500
     GO TO 1480
1490 K1 = KDTA
     WRITE (7,1470) D(K1),T(K1),S(K1),ISTA,WMONTH,K1,J
C
C
C     ****************************************************************
C     JKEC IS INCREMENTED HERE BY 1 TO ACCOUNT FOR TAPE ID LABEL FOR
C     NEXT STATION TO BE PROCESSED.  THIS KEEPS SERIALIZATION OF
C     RECORDS ON TAPE CONSECUTIVE AND INCLUDES LABELS FOR EACH STATION.
```

```
 1500 JREC = JREC+1
C      **********************************************************************
C
C
 1510 IF (ENDFL) END FILE 8
C
C      NORMALLY, ENDFL MUST BE TRUE ONCE ON THE LAST TAPE WRITING
C      OPERATION. HOWEVER, IT IS NOT REQUIRED BY IBM.  IT IS WRITTEN
C      ALWAYS AFTER LAST TAPE WRITING OPERATION WITHOUT COMMAND.
C
C      ********************************************************************
C      ******** INITIALIZE VARIABLES AND ARRAYS FOR NEXT STATION *******
C
C
      DO 1520 J=1,1801
      D(J) = 0.0
      T(J) =-5.0
      S(J) = 0.0
      D2(J) = 0.0
      T2(J) =-5.0
      S2(J) = 0.0
      T1(J) =-5.0
      S1(J) = 0.0
      IREC(J) = 0
 1520 CONTINUE
C
C
      INSA(1) = 1
      INSA(2) = 1
      INTA(1) = 1
      INTA(2) = 1
      KBARF = 0
      KSCARF = 0
C
C
      DO 1530 J=3,10
      INSA(J) = 980
      INTA(J) = 980
 1530 CONTINUE
C
C
      KS = 1
      KT = 1
C
C
      DO 1540 J=1,50
      SH(J) = 0.0
      TH(J) =-5.0
```

```
      DH(J) = 0.0
 1540 CONTINUE
C
C
      SKIP = .FALSE.
      JSAV = 0
      KDTAF = 1
      IDEPTH = 0
      IH = 0
      IP = 0
      IF (NOIRG.EQ.1) GO TO 400
      GO TO 1570
C
C      ***************************************************************
C      *********************** R E T U R N ***************************
C
 1550 CONTINUE
 1560 FORMAT ('1')
 1570 IT = IT+1
      GO TO 150
 1580 STOP
      END
C     ---------------SUBROUTINE OUT1 MOD1,JUNE 1975-------------------
      SUBROUTINE OUT1 (D,T,S,SV,SIG,N,ISTA,WMONTH,IREC,JREC,ISQZ)
      REAL *8WMONTH
      DIMENSION D(1), T(1), S(1), SV(1), SIG(1), IREC(1)
C      PRODUCE HEADING
   20 WRITE (6,30) ISTA,WMONTH,ISQZ
   30 FORMAT (//T38,'OCEANOGRAPHIC DATA FROM U C M II'//T41,'STATION ',
     1 I3,A12/T41,'COMPRESSED BY FACTOR ',I3///)
C      FORMAT FOR PRINTING TWO BLOCKS OF DATA PER PAGE.
      WRITE (6,40)
   40 FORMAT (T6,'DEPTH',T14,'TEMP.',T20,'SALNTY.',T28,'SND.VEL.',T36,'
     1 SIGMA-T',T48,'DEPTH',T56,'TEMP.',T62,'SALNTY.',T70,'SND.VEL.',
     2 T80,'SIGMA-T')
      WRITE (6,50)
   50 FORMAT (T6,'METERS',T14,'DEG.C.',T21,'PPT.',T29,'M/SEC',T48,
     1 'METERS',T56,'DEG.C.',T63,'PPT.',T71,'M/SEC'/)
      NN = N/2
      NO = N-2*NN
C
C
      DO 60 J=1,NN,ISQZ
      K = NN+J
      WRITE (6,70) D(J),T(J),S(J),SV(J),SIG(J),D(K),T(K),S(K),SV(K),SIG(
     1K),IREC(J),IREC(K)
   60 CONTINUE
C
```

```
C
   70 FORMAT (T6,F5.1,T14,F5.2,T21,F5.2,T28,F7.2,T39,F6.3,T48,F5.1,T56,F
     15.2,T63,F5.2,T70,F7.2,T81,F6.3,T90,2I8)
      IF (NO.EQ.0) GO TO 90
      WRITE (6,80) D(N),T(N),S(N),SV(N),SIG(N),IREC(N)
   80 FORMAT (T48,F5.1,T56,F5.2,T63,F5.2,T70,F7.2,T81,F6.3,T90,8X,I8)
   90 WRITE (6,100)
  100 FORMAT ('1')
      RETURN
      END
C       ----------------------- SUBROUTINE CHMOVE -----------------------
      SUBROUTINE CHMOVE (A,I,B,J)
C       THIS SUBROUTINE RETURNS A LOGICAL*1 VARIABLE TO A 4-BYTE ADDRESS
C       IN THE MAIN PROGRAM, UNPACKING THE ORIGINAL 4-BYTE WORDS A
C       BYTE AT A TIME.
      LOGICAL *1A(1),B(1)
      B(J) = A(I)
      RETURN
      END
C       ---------------SUBROUTINE SVEL MOD.1,JUNE 73---------------
      SUBROUTINE SVEL (AA,BB,CC,SV,K1)
C       THIS COMPUTES SOUND VELOCITY FROM DEPTH, TEMPERATURE AND SALINITY
C       ACCORDING TO WILSON'S EQUATION
      DIMENSION AA(1), BB(1), CC(1), SV(1)
C
C
      DO 30 J=1,K1
      Z = AA(J)
      T = BB(J)
      S = CC(J)
      IF (T.LT.-1.99.OR.S.LT.0.1) GO TO 20
      P = .1027*Z+1.282E-7*Z*Z
      T2 = T*T
      T3 = T2*T
      VT = 4.5721*T-4.4532E-2*T2-2.6045E-4*T3+7.9851E-6*T3*T
      P2 = P*P
      P3 = P2*P
      P4 = P2*P2
      VP = .160272*P+1.0268E-5*P2+3.5216E-9*P3-3.3603E-12*P4
      SR = S-35.
      VS = 1.39799*SR+1.69202E-3*SR*SR
      VSTP = SR*(-1.1244E-2*T+7.7711E-7*T2+7.7016E-5*P-1.2943E-7*P2+3.15
     180E-8*P*T+1.579E-9*P*T2)+P*(-1.8607E-4*T+7.4812E-6*T2+4.5283E-8*T3
     2)+P2*(-2.5294E-7*T+1.8563E-9*T2)+P3*(-1.9646E-10*T)
      SV(J) = 1449.14+VT+VP+VSTP+VS
      GO TO 30
   20 SV(J) = 0.
   30 CONTINUE
```

```
C
C
      RETURN
      END
C       ------------------------ SUBROUTINE SIGMT ----------------------
      SUBROUTINE SIGMT (AA,BB,SIG,K1)
C      THIS SUBROUTINE COMPUTES SIGMA-T FROM SALINITY AND
C      TEMPERATURE ACCORDING TO H.O.614 P.91
      DIMENSION AA(1), BB(1), SIG(1)
C
C
      DO 30 J=1,K1
      S = AA(J)
      T = BB(J)
      IF (T.LT.-1.99.OR.S.LT.0.1) GO TO 20
      CL = (S-0.03)/1.805
      B = T*(18.03-0.8164*T+0.01667*T**2)*10.**(-6)
      A = T*(4.7867-0.098185*T+0.0010843*T**2)*10.**(-3)
      SG = -0.069+1.4708*CL-0.001570*CL**2+0.0000398*CL**3
      SGA = -((T-3.98)**2/503.57)*((T+283)/(T+67.26))
      SIG(J) = SGA+(SG+0.1324)*(1-A+B*(SG-0.1324))
      GO TO 30
   20 SIG(J) = 0.
   30 CONTINUE
C
C
      RETURN
      END
C       ---------------------- SUBROUTINE CONDNS -----------------------
      SUBROUTINE CONDNS (X,Y,T1,JJJ,NE,KDT1,KDTH1,KDTH2)
C
C      SUBROUTINE CONDNS MOD. 3,17 SEPT 74  BY R. G. PAQUETTE.
C
C      THIS SUBROUTINE FINDS THE ARRAY LOCATIONS FOR X, INDEXED
C      SEQUENTIALLY FOR EACH UNIT OF Y.  EACH UNIT OF Y IS 1.0 AND
C      CORRESPONDS TO .01 INCHES OF TRAVEL IN THE DEPTH DIRECTION.
C      MOD. 3 FILLS IN BLANK ARRAY POSITIONS DUE TO THE DIGITIZER STEPP-
C      ING AHEAD MORE THAN .01 INCHES AT A STEP AND WRITES A MESSAGE
C      CN THE PRINTER.
      DIMENSION X(1), Y(1), T1(1), KINS(10), KNO(10)
C
C      IF FIRST INDEX IS ZERO OR NEGATIVE THERE IS A MISBEHAVIOR ELSE-
C      WHERE IN THE PROGRAM.  RESET JJJ TO 1.
      IF (JJJ.GE.1) GO TO 30
      JJJ = 1
      WRITE (6,20)
   20 FORMAT (/5X,'****** JJJ RESET TO ONE - SOMETHING WRONG ******'/)
C      KDTH1 BECOMES THE INDEX OF THE START OF THIS ARRAY SEGMENT.
```

```
   30 KDTH1 = Y(JJJ)+1.50
C      IF KDTH1 BECOMES ZERO OR LESS(THE ORIGIN OF MEASUREMENT IS
C      POSITIVE WITH RESPECT TO THE START OF TRACE), USE THE START
C      OF THE CURVE AS THE ORIGIN OF INDEXING.
C      THIS CAUSES AN OVERLAP BETWEEN ARRAYS, BUT IT SHOULD BE SMALL.
      XINC = 0.
      IF (KDTH1.GT.0) GO TO 40
      XINC = FLOAT(1-KDTH1)
      KDTH1 = 1
C
   40 JJ1 = JJJ+1
      NE1 = NE-1
C      FORM SUBSCRIPTS FROM THE DEPTH INCREMENTS AND STORE X'S AT THOSE
C      ARRAY LOCATIONS.
C      SEARCH FOR BLANKS IN ARRAY BETWEEN INDEXES KDTH1 AND KDTH2.
C      KCT COUNTS THE NUMBER OF BLANKS
      KCT = 0
      KSAV = KDTH1
C      KINS(J) IS THE NUMBER OF THE ARRAY POSITION FILLED.
C
C
      DO 50 J=1,10
      KNO(J) = 0
   50 KINS(J) = 0
C
C
C
C
      DO 80 J=JJ1,NE1
      KDTH = Y(J)+1.50+XINC
      T1(KDTH) = X(J)
C      TEST TO SEE IF INDEX IS THE SAME OR ONE GREATER THAN THE LAST
C      ONE.  IF NOT, INTERPOLATE VALUES.
      NREP = KDTH-KSAV
      IF (NREP.LE.1) GO TO 70
      KCT = KCT+1
      IF (KCT.GT.10) KCT = 10
      KNO(KCT) = NREP
      KINS(KCT) = KDTH
      II = KSAV+1
      III = KDTH-1
      E = FLOAT(NREP)
      G = T1(KDTH)
      F = G-T1(KSAV)
C
C
      DO 60 I=II,III
   60 T1(I) = (FLOAT(I-KSAV)/E)*F+T1(KSAV)
```

```
C
C
   70 KSAV = KDTH
   80 CONTINUE
C
C
      KDTH2 = Y(NE)+1.50+XINC
C       INSERT THE FIRST POINT, WHICH OTHERWISE WOULD BE THE LAST
C       ONE FOR WHICH Y(J).LT.1.
      T1(KDTH1) = X(JJJ)
      T1(KDTH2) = X(NE)
C       SAVE INDEX OF END OF ARRAY.
C
C
C       WRITE DOWN NUMBER AND LOCATIONS OF INTERPOLATED VALUES.
      WRITE (6,90) KCT,(KINS(I),I=1,KCT),(KND(I),I=1,KCT)
   90 FORMAT (/5X,'BLANK ARRAY POSITIONS FILLED IN ',I3,' PLACES.  BEGIN
     1NING INDEXES AND NO. OF STEPS'/5X,'(10 EACH) ARE: ',5X,10I6/
     2 5X,10I6/)
      RETURN
      END
//LINK.SYSIN DD *
BESD          &    ATPRD              B2
BTXT          8    A&%&<Q|AOAQ&$ D&' HQ$Q1Q-0 &-ADQ-ODQ   &-AHA-AQJ&-OG&  J
BTXT     8    F    AANG- &
BTXT     =    8    AG GO H    CQ& D (G E& Q  AQ LJ&-OG- =Q&-%QR -$WCZ I<-BOQ&
BTXT     6    8    A &QR OAO& &&A&KGA-& Q AH  A=Q&AD&&A<KBA9A(K G- :K7A8E&AF
BTXT     >    8    AKbA8E&A*GO BE&AFE&A*AO  Q) DQ_ <Q<&MG=KD EE& -  AQ MK AN
BTXT     W    8    AGO BQ&A&KGAY& Q&ADK|& A-KH EGO QK B%KGAOA8K"AMA&B<  G9J
BTXT    A;    8    AB%G&A>A&B%A  A AN"B%G AON(BQGO  NDB<GO  Q&-<F&&&-<A&AQ 7
BTXT    AO    8    AG9
BTXT    A+    8    A                                              B   -
BTXT    AF    8    A                                             A      B<    M
BTXT    A=    +    A  METTAP  B &H
BTXT    B<    U    A      B%         AO  AQ     A
BTXT    BO    B    A
BRLD          -      A AI  NI  )( A4I A9I BJI B)H B/
BEND                                   F15OCT70 14.39  5/25/75
//GO.FT06F001 DD SPACE=(CYL,(10,01)),SYSOUT=O
//GO.FT07F001 DD DUMMY
//GO.SYSIN DD *
 &CONTRL NN=425,TAPE=F,CARDS=F,GCARDS=F,ISQZ=01,NRCSKP=52,TCOR=-0.08,
 IGSQZ=08,ICSQZ=08,&END
    UCM017     INCLUDES STATIONS 302C THRU 317C
 STATION 302C TEMPERATURE HEADER                                          C
 &DAT ISTA=302,AMONC='C',IDEPTH=99,IDSCL=1,ICODE=0,ITSCL=4,ISCL=3,IP=0,&END
 STATION 302C TEMPERATURE TRACE
 &DAT  IDEPTH=00&END
```

```
STATION 302C TEMPERATURE HEADER                                          C
&DAT IDEPTH=99,ITSCL=3&END
STATION 302C TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 302C TEMPERATURE HEADER                                          C
&DAT IDEPTH=99,IDSCL=2&END
STATION 302C TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 302C TEMPERATURE HEADER                                          C
&DAT IDEPTH=99,ITSCL=2&END
STATION 302C TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 302C SALINITY HEADER                                             C
&DAT IDSCL=1,IDEPTH=99,ICODE=1,ITSCL=4,&END
STATION 302C SALINITY TRACE                                              C
&DAT  IDEPTH=00&END
STATION 302C SALINITY HEADER                                             C
&DAT IDSCL=2,IDEPTH=99,IP=1,&END
STATION 302C SALINITY TRACE                                              C
&DAT  IDEPTH=00&END
STATION 303C TEMPERATURE HEADER                                          C
&DAT ISTA=303,AMONC='C',IDEPTH=99,IDSCL=1,ICODE=0,ITSCL=4,ISCL=3,IP=0,
DH=0.0,0.3,0.6,1.0,
TH=13.54,13.48,13.48,13.48,
SH=33.47,33.47,33.47,33.47,IH=4,&END
STATION 303C TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 303C TEMPERATURE HEADER                                          C
&DAT IDEPTH=99,ITSCL=3&END
STATION 303C TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 303C TEMPERATURE HEADER                                          C
&DAT IDEPTH=99,IDSCL=2&END
STATION 303C TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 303C TEMPERATURE HEADER                                          C
&DAT IDEPTH=99,ITSCL=2&END
STATION 303C TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 303C SALINITY HEADER                                             C
&DAT IDSCL=1,IDEPTH=99,ICODE=1,ITSCL=4,&END
STATION 303C SALINITY TRACE                                              C
&DAT  IDEPTH=00&END
STATION 303C SALINITY HEADER                                             C
&DAT IDSCL=2,IDEPTH=99,IP=1,&END
STATION 303C SALINITY TRACE                                              C
&DAT  IDEPTH=00&END
STATION 304C TEMPERATURE HEADER                                          C
```

```
&DAT ISTA=304,AMONC='C',IDEPTH=99,IDSCL=1,ICODE=0,ITSCL=4,ISCL=3,IP=0,&END
STATION 304C TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 304C TEMPERATURE HEADER                                              C
&DAT IDEPTH=99,ITSCL=3&END
STATION 304C TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 304C TEMPERATURE HEADER                                              C
&DAT IDEPTH=99,IDSCL=2&END
STATION 304C TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 304C SALINITY HEADER                                                 C
&DAT IDSCL=1,IDEPTH=99,ICODE=1,ITSCL=4,&END
STATION 304C SALINITY TRACE                                                  C
&DAT  IDEPTH=00&END
STATION 304C SALINITY HEADER                                                 C
&DAT IDSCL=2,IDEPTH=99,IP=1,&END
STATION 304C SALINITY TRACE                                                  C
&DAT  IDEPTH=00&END
STATION END                                                                  1
//GO.METTAP DD UNIT=2400-1,VOL=SER=UCM017,DISP=OLD,LABEL=(,NL),
//       DCB=(DEN=1,TRTCH=ET)
```

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